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Titre :

Title :

Maritime navigation and radiocommunication equipment and systems - Electronic chart display and information system (ECDIS) - Operational and performance requirements, methods of testing and required test results.

Note d'introduction

Introductory note

This revision of the first edition adds an important annex on the testing of Raster Chart Display Systems (RCDS) now approved under certain circumstances by the IMO. Also a number of tests have been revised and the document thoroughly checked for accuracy of references etc.

ATTENTION
Parallel IEC CDV/CENELEC Enquiry)**ATTENTION**
CDV soumis en parallèle au vote (CEI) et à l'enquête (CENELEC)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**MARITIME NAVIGATION AND RADIOCOMMUNICATION
EQUIPMENT AND SYSTEMS -****Electronic Chart Display and Information System (ECDIS)
Operational and performance requirements,
methods of testing and required test results**

FOREWORD

- 1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, the IEC publishes International Standards. Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 61174 has been revised by maintenance Team1, of IEC technical committee 80:

The text of this standard is based on the following documents:

FDIS	Report on voting
XX/XX/FDIS	XX/XX/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 3.

The committee has decided that the contents of this publication will remain unchanged until _____. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

INTRODUCTION

For this second edition of the standard, the maintenance team completed the following tasks:

- a) Developed minimum operational and performance requirements for the RCDS mode of operation in accordance with appendix 7 of the IMO performance standards as amended by IMO resolution MSC.86, importing much of the text from appendix 7 to produce an unambiguous and user-friendly annex to this standard.
- b) Developed separate tests for back-up arrangements as defined by appendix 6 of the IMO performance standards.
- c) Clarified the color tolerance requirements and created allowances for the separate testing of monitors.
- d) Performed an extensive review of the document to ensure proper referencing and language throughout.

Technical committee 80 recognizes that there is further work to be accomplished in this standard, and a future revision is anticipated within 12-18 months, to incorporate some critical hydrographic considerations including the RNC test data set, several S-57 definitions and tests and harmonisation of the navigation related symbols.

Annexes A, B, C, D, E, F and I form an integral part of this standard.

Annex G provides operational and performance requirements, methods of testing and required test results for adequate independent back-up arrangements, which shall ensure safe navigation in case of ECDIS failure.

Annex H provides operational and performance requirements, methods of testing and required test results for the Raster Chart Display System (RCDS) mode of operation.

MARITIME NAVIGATION AND RADIOCOMMUNICATION EQUIPMENT AND SYSTEMS -

Electronic Chart Display and Information System (ECDIS) Operational and performance requirements, methods of testing and required test results

1 Scope

This International Standard specifies the performance requirements, methods of testing and required test results of equipment conforming to performance standards not inferior to those adopted by the IMO in resolution A.817 as amended by annex 5 to IMO resolution MSC.64 and annex 4 to IMO resolution MSC.86.

This standard is based upon the performance standards of IMO resolution A.817, and is also associated with IMO resolution A.694 and IEC 60945. Reference is made, where appropriate, to IMO resolution A.817, and all subclauses whose wording is identical to that in the resolution are printed in italics.

In association with the above IMO resolution A.817, are the International Hydrographic Organization (IHO) special publications S-52, S-57 and S-61. This standard has included extracts from the above publications where they are applicable to this equipment. Where reference is made, all subclauses whose wording is identical to that in the publications, are printed in italics.

The requirements of this standard are not intended to prevent the use of new techniques in equipments and systems, provided the facilities offered are not inferior to those stated.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60872-1:1998, *Marine automatic radar plotting aids (ARPA) – Radar plotting aids - Part 1: Automatic radar plotting aids (ARPA) – Methods of testing and test results*

IEC 60945:1996, *Maritime navigation and radiocommunication equipment and systems – General requirements – Methods of testing and required test results*

IEC 61162-1:1999, *Maritime navigation and radiocommunication equipment and systems – Digital interfaces – Part 1: Single talker and multiple listeners*

ISO 9000 (all parts), *Quality management and quality assurance standards*

IMO:1974 (as amended), *Convention for safety of life at sea (SOLAS)*

IMO A.424:1979, *Performance standards for gyro-compasses*

IMO A.686:1991, *Code on alarms and indicators*

IMO A.694:1991, *General requirements for shipborne radio equipment forming part of the global maritime distress and safety system (GMDSS) and for electronic navigational aids*

IMO A.817:1995, *Performance standards for electronic chart display and information systems (ECDIS)*

IMO A.821:1995, *Performance standards for gyro-compasses for high-speed craft*

IMO A.823:1995, *Performance standards for automatic radar plotting aids (ARPAs)*

IMO A.824:1995, *Performance standards for devices to indicate speed and distance*

IMO MSC.64(67):1996, Annex 4 – *Performance standards for radar equipment*

IMO MSC.64(67):1996, Annex 5 – *Amendment to IMO A.817*

IMO MSC.86(70):1998, Annex 4 – *Amendments to IMO A.817*

IHO S-52:1996, *Specifications for chart content and display aspects of ECDIS*

IHO S-52 appendix 1:1996, *Guidance on updating the electronic navigational chart*

IHO S-52 appendix 2:1997 (as amended), *Colour and symbol specifications for ECDIS*

IHO S-52 appendix 3:1997, *Glossary of ECDIS-related terms*

IHO S-57:1996 (as amended), *Transfer standard for digital hydrographic data*

IHO S-61:1999, *Product specification for raster navigational charts (RNC)*

IHO:1997, *Test data set for use with IEC 61174*

3 Definitions and abbreviations

Definitions of ECDIS related terms pertaining to IMO performance standards for ECDIS are listed in 4.2. A glossary of ECDIS related terms is included in S-52 appendix 3.

For the purpose of this standard the following definitions and abbreviations apply.

3.1 Definitions

3.1.1

CIE colour calibration

procedure to confirm that the colour specified in S-52 appendix 2 is correctly reproduced on the ECDIS display

3.1.2

common reference system

sensor input data, providing identical and obligatory reference pertaining to position, course, heading, bearing, speed, velocity, etc. and horizontal datum to different subsystems within an integrated navigation system

3.1.3

compilation scale

scale with which the chart information meets the IHO requirements for chart accuracy. It is established by the producing hydrographic office and encoded in the ENC

3.1.4**corrupted data**

ENC data produced according to the S-57 ENC product specification, but altered or modified during production, transmission, or retrieval

3.1.5**degrade**

reduce the information content of

3.1.6**display redraw time**

interval from when the display starts to change until the new display is complete

3.1.7**display regeneration time**

interval from operator action until the consequent redraw is complete

3.1.8**display scale**

ratio between a distance on the display and a distance on the ground, normalized and expressed as, for example, 1:10 000

3.1.9**ENC cell**

geographic division of ENC data for distributing purposes. For further information, refer to the ENC product specification in S-57

3.1.10**ENC data**

data conforming to 4.2.2

3.1.11**ENC test data set**

standardized data set supplied on behalf of the IHO that is necessary to accomplish IEC testing requirements for ECDIS. This data set is encoded according to the S-57 ENC product specification and contains update information based on S-52 appendix 1. The specific requirements are listed in annex F

3.1.12**non-ENC data**

data not conforming to 4.2.2

3.1.13**overscale**

display of the chart information at a display scale larger than the compilation scale. Overscaling may arise from deliberate overscaling by the mariner, or from automatic overscaling by ECDIS in compiling a display when the data included is at various scales

3.1.14**presentation library**

implementation of the display specifications in S-52, appendix 2 “Colour and Symbol Specifications for ECDIS”, by de-coding and symbolizing the SENC. It contains:

- a) the ECDIS symbol library, including the IEC navigation symbols;
- b) the ECDIS colour tables for day, dusk, and night viewing;
- c) look-up tables, linking SENC objects to the appropriate colour and symbology;
- d) conditional symbology procedures for:
 - cases where symbolizing depends on circumstances, such as the mariner’s choice of safety contour;

- cases where symbolizing is too complex to be defined in a direct look-up table;
- e) description of symbology instructions;
- f) mariner's navigation objects, specified in the same format as chart objects for convenience of processing in ECDIS;
- g) supplementary features, for example ECDIS chart 1 colour differentiation test diagrams and colour calibration software.

The presentation library is available in hard-copy or in digital form. The symbols shall be replicated in size and shape, using any convenient format. The colour tables shall be reproduced within the tolerances given in S-52 appendix 2/5.2.3. The remaining items may be implemented in any convenient form which produces the same results as the presentation library.

3.1.15

single operator action

single operation shall be achieved by activating a hardkey or softkey, including any necessary cursor movement

3.1.16

RNC data

data conforming to H.2.2

3.1.17

RNC test data set

standardized data set supplied on behalf of the IHO that is necessary to accomplish IEC testing requirements for RCDS mode of operation. This data set is encoded according to the S-61 RNC product specification. The specific requirements are listed in H.18.

3.2 Abbreviations

AIS	Automatic identification system
ARPA	Automatic radar plotting aid
ATA	Automatic tracking aid
CIE	Comité International de l' Eclairage
EBL	Electronic bearing line
ECDIS	Electronic chart display and information system
ENC	Electronic navigational chart
EPA	Electronic plotting aid
EPFS	Electronic position fixing system
EUT	Equipment under test
GMDSS	Global maritime distress and safety system
HO	Hydrographic office
IEC	International Electrotechnical Commission
IHO	International hydrographic organization
IMO	International maritime organization
RCDS	Raster chart display system
RNC	Raster navigational chart
SENC	System electronic navigational chart
SOLAS	Safety of life at sea
SRNC	System raster navigational chart
VRM	Variable range marker

4 Minimum operational and performance requirements

4.1 Introduction

NOTE – In the following subclauses of clause 4, the text in *italics* is from the corresponding paragraph of the annex to IMO resolution A.817. For example, 4.1.1 is paragraph 1.1 from the annex of A.817.

4.1.1 *The primary function of the ECDIS is to contribute to safe navigation.*

4.1.2 *ECDIS with adequate back-up arrangements may be accepted as complying with the up-to-date charts required by regulation V/20 of the 1974 SOLAS Convention.*

4.1.3 *In addition to the general requirements for shipborne radio equipment forming part of the global maritime distress and safety system (GMDSS) and the requirements for electronic navigational aids contained in IMO resolution A.694 (IEC 60945), ECDIS shall meet the requirements of IMO resolution A.817.*

4.1.4 *ECDIS shall be capable of displaying all chart information necessary for safe and efficient navigation originated by, and distributed on the authority of, government authorized hydrographic offices.*

4.1.5 *ECDIS shall facilitate simple and reliable updating of the electronic navigational chart.*

4.1.6 *Use of ECDIS shall reduce the navigational workload as compared to use of the paper chart. It shall enable the mariner to execute in a convenient and timely manner all route planning, route monitoring and positioning currently performed on paper charts. It shall be capable of continuously plotting the ship's position.*

4.1.7 *ECDIS shall have at least the same reliability and availability of presentation as the paper chart published by government authorized hydrographic offices.*

4.1.8 *ECDIS shall provide appropriate alarms or indications with respect to the information displayed or malfunction of the equipment. (See annex D.)*

4.1.9 *When the relevant chart information is not available in the appropriate form, some ECDIS equipment may operate in the Raster Chart Display System (RCDS) mode as defined in annex H. Unless otherwise specified in annex H, the RCDS mode of operation shall conform to performance standards not inferior to those set out in IMO resolution A.817.*

4.2 ECDIS definitions

For the purpose of this standard:

4.2.1 *Electronic chart display and information system (ECDIS) means a navigation information system which with adequate backup arrangements can be accepted as complying with the up-to-date chart required by regulation V/20 of the 1974 SOLAS Convention, by displaying selected information from a system electronic navigational chart (SENC) with positional information from navigation sensors to assist the mariner in route planning and route monitoring, and by displaying additional navigation-related information.*

The reference geodetic datum is WGS-84.

4.2.2 *Electronic navigational chart (ENC) means the database, standardized as to content, structure and format, issued for use with ECDIS on the authority of government authorized hydrographic offices. The ENC contains all the chart information necessary for safe navigation and may contain supplementary information in addition to that contained in the paper chart (e.g. sailing directions) which may be considered necessary for safe navigation.*

The content, structure and format of the ENC are specified in S-57, including the associated ENC product specification.

4.2.3 *System electronic navigational chart (SENC) means a database resulting from the transformation of the ENC by ECDIS for appropriate use, updates to the ENC by appropriate means, and other data added by the mariner. It is this database that is actually accessed by ECDIS for the display generation and other navigational functions, and is the equivalent of an up-to-date paper chart. The SENC may also contain information from other sources.*

4.2.4 *Standard display means the SENC information that shall be shown when a chart is first displayed on ECDIS. The level of the information it provides for route planning or route monitoring may be modified by the mariner according to the mariner's needs.*

4.2.5 *Display base means the level of SENC information which cannot be removed from the display, consisting of information which is required at all times in all geographic areas and all circumstances. It is not intended to be sufficient for safe navigation.*

4.2.6 *Further information on ECDIS definitions may be found in S-52 appendix 3.*

4.3 Display of SENC information

4.3.1 *ECDIS shall be capable of displaying all SENC information. (See 6.5.1 and 6.8.2 to 6.8.5.)*

4.3.2 *SENC information available for display during route planning and route monitoring shall be subdivided into three categories, display base, standard display and all other information. (See annex A.) (See 6.8.2 through 6.8.4.)*

4.3.3 *ECDIS shall present the standard display at any time by a single operator action. (See 6.8.2.)*

4.3.4 *When a chart is first displayed on ECDIS, it shall provide the standard display at the largest scale available in the SENC for the displayed area. (See 6.8.1.)*

This is only applicable when the first chart is displayed subsequent to power up. The scale of an ENC is indicated by its compilation scale.

4.3.5 *It shall be easy to add or remove information from the ECDIS display. It shall not be possible to remove information contained in the display base. (See 6.8.2.)*

The addition or removal of information shall be limited to categories of information, e.g. prohibited and restricted areas, spot soundings; not individual items, e.g. an individual area or an individual sounding. (See annex A/2-3.)

4.3.6 *It shall be possible for the mariner to select a safety contour from the depth contours provided by the SENC. ECDIS shall give the safety contour more emphasis than other contours on the display. (See 6.8.8.)*

4.3.7 *It shall be possible for the mariner to select a safety depth. ECDIS shall emphasize soundings equal to or less than the safety depth whenever spot soundings are selected for display. (See 6.8.9.)*

4.3.8 *The ENC and all updates to it shall be displayed without any degradation of their information content. (See 6.8.)*

Degradation shall be understood as degradation in information quantity as well as quality with respect to a standard test chart provided by government authorized hydrographic offices.

4.3.9 *ECDIS shall provide a method of ensuring that the ENC and all updates to it have been correctly loaded into the SENC. (See 6.8.15.2.)*

4.3.10 *The ENC data and updates to it shall be clearly distinguishable from other displayed information, such as, for example, that listed in annex B. (See 6.8.5 and 6.8.15.2.)*

Adherence to the IHO colours and symbols satisfies this requirement.

4.4 Provision and updating of chart information

(See S-52 appendix 1.)

4.4.1 *The chart information to be used in ECDIS shall be the latest edition of information originated by a government-authorized hydrographic office, and conform to IHO standards. (See 6.5.)*

In order to identify the date and origin of the ENC in use, the ECDIS shall include a graphical index of ENC data available, presented upon the mariner's request and providing access to the edition and date of each cell. (See S-52 6.3(c).)

A new edition of an ENC will supersede a previous ENC and its integrated updates issued by a government authorized hydrographic office.

4.4.2 *The contents of the SENC shall be adequate and up to date for the intended voyage, as required by regulation V/20 of the 1974 SOLAS Convention. (See 6.5.)*

4.4.3 *It shall not be possible to alter the contents of the ENC.*

4.4.4 *Updates shall be stored separately from the ENC. (See 6.8.15.2.)*

Separate storage of updates may utilize the same data storage area.

4.4.5 *ECDIS shall be capable of accepting official updates to the ENC data provided in conformity with IHO standards. These updates shall be automatically applied to the SENC. By whatever means updates are received, the implementation procedure shall not interfere with the display in use.*

The contents of an update assume that all earlier updates have been applied to the SENC. A new edition of an ENC shall supersede a previous ENC and its updates.

4.4.6 *ECDIS shall also be capable of accepting updates to the ENC data entered manually with simple means for verification prior to the final acceptance of the data. They shall be distinguishable on the display from ENC information and its official updates and not affect display legibility. (See 6.8.5 and 6.8.16.)*

4.4.7 *ECDIS shall keep a record of updates including time of application to the SENC (See 6.8.15.3.)*

The record shall include updates for each ENC until it is superseded by a new edition.

4.4.8 *ECDIS shall allow the mariner to display updates so that the mariner may review their contents and ascertain that they have been included in the SENC. (See 6.8.15.2.)*

4.5 Scale

ECDIS shall provide an indication if: (See 6.8.6.)

- 1 the information is displayed at a larger scale than that contained in the ENC; or*
- 2 own ship's position is covered by an ENC at a larger scale than that provided by the display.*

4.6 Display of other navigational information

4.6.1 *Radar information or other navigational information may be added to the ECDIS display. However, it shall not degrade the SENC information, and shall be clearly distinguishable from the SENC information. (See 6.8.3, 6.8.4 and 6.8.13.)*

4.6.2 *ECDIS and added navigational information shall use a common reference system. If this is not the case, an indication shall be provided. (See 6.8.12 g.)*

Such advice shall be included in the manufacturer's installation handbook.

4.6.3 Radar and plotting information

4.6.3.1 *Transferred radar information may contain both the radar image and ARPA or ATA or EPA information. (See 6.2.)*

Where plotting information is added it shall be indicated to the operator whether the vectors are relative or true, and if true whether they are sea or ground stabilized.

4.6.3.2 *If the radar image is added to the ECDIS display, the chart and the radar image shall match in scale and in orientation. (See 6.8.13.)*

Additionally the ECDIS and radar image shall match in projection.

4.6.3.3 *The radar image and the position from the position sensor shall both be adjusted automatically for antenna offset from the conning position. (See 6.8.13.)*

4.6.3.4 *It shall be possible to adjust the displayed position of the ship manually so that the radar image matches the SENC display. (See 6.8.13.)*

If an offset is applied, it shall be clearly indicated. The details of the offset shall be readily available.

4.6.3.5 *It shall be possible to remove the radar or plotting information by single operator action. (See 6.8.13.)*

4.7 Display mode and generation of the neighbouring area

4.7.1 *It shall always be possible to display the SENC in a 'north-up' orientation. Other orientations are permitted. (See 6.8.7.)*

4.7.2 *ECDIS shall provide for true motion mode. Other modes are permitted. (See 6.8.7.)*

4.7.3 *When true motion mode is in use, reset and generation of the neighbouring area shall take place automatically at a distance from the border of the display determined by the mariner. (See 6.8.7.)*

4.7.4 *It shall be possible to manually change the chart area and the position of own ship relative to the edge of the display. (See 6.8.7.)*

4.8 Colours and symbols

4.8.1 *IHO recommended colours and symbols shall be used to represent SENC information. (See S-52 appendix 2.) (See 6.7.1.)*

4.8.2 *The colours and symbols other than those mentioned in 4.8.1 shall be those used to describe the navigational elements and parameters listed in annex B and published in annex E. (See 6.7.1.)*

4.8.3 *SENC information, when displayed at the scale specified in the ENC, shall use the specified size of symbols, figures and letters. (See S-52 appendix 2.) (See 6.7.1.)*

4.8.4 *ECDIS shall allow the mariner to select whether own ship is displayed in true scale or as a symbol. (See 6.7.1.)*

4.9 Display requirements

4.9.1 *ECDIS shall be capable of displaying information for: (See 6.9.2 and 6.9.3.)*

- .1 route planning and supplementary navigation tasks;*
- .2 route monitoring.*

4.9.2 *The effective size of the chart presentation for route monitoring shall be at least 270 mm by 270 mm. (See 6.7.5.)*

4.9.3 *The display shall be capable of complying with the colour and resolution recommendations of IHO. (See S-52 appendix 2.) (See 6.7.3 and 6.7.4.)*

4.9.4 *The method of presentation shall ensure that the displayed information is clearly visible to more than one observer in the conditions of light normally experienced on bridge of the ship by day and by night. (See 6.7.5.)*

4.10 Route planning, monitoring and voyage recording

4.10.1 *It shall be possible to carry out route planning and route monitoring in a simple and reliable manner. (See 6.9.1.)*

4.10.2 *ECDIS shall be designed following ergonomic principles for user-friendly operation. (See 6.9.1.)*

4.10.3 *The largest scale data available in the SENC for the area given shall always be used by the ECDIS for all alarms or indications of crossing the ship's safety contour and of entering a prohibited area, and for alarms and indications according to annex C. (See 6.9.3.)*

4.10.4 Route planning

4.10.4.1 *It shall be possible to carry out route planning including both straight and curved segments. (See 6.9.2.)*

4.10.4.2 *It shall be possible to adjust a planned route by, for example: (See 6.9.2.)*

- .1 adding waypoints to a route;*
- .2 deleting waypoints from a route;*
- .3 changing the position of a waypoint;*
- .4 changing the order of the waypoints in the route.*

4.10.4.3 *It shall be possible to plan an alternate route in addition to the selected route. The selected route shall be clearly distinguishable from the other routes. (See 6.9.2.)*

4.10.4.4 *An indication is required if the mariner plans a route across an own ship's safety contour. (See 6.9.2.)*

4.10.4.5 *An indication is required if the mariner plans a route across the boundary of a prohibited area or of a geographic area for which special conditions exist. (See annex C.) (See 6.9.2.)*

4.10.4.6 *It shall be possible for the mariner to specify a limit of deviation from the planned route at which activation of an automatic offtrack alarm shall occur. (See 6.9.2.)*

4.10.5 Route monitoring

4.10.5.1 *For route monitoring the selected route and own ship's position shall appear whenever the display covers that area. (See 6.9.3.)*

4.10.5.2 *It shall be possible to display a sea area that does not have the ship on the display (e.g. for look ahead, route planning), while route monitoring. If this is done on the display used for route monitoring, the automatic route monitoring functions (e.g. updating ship's position, and providing alarms and indications) shall be continuous. It shall be possible to return to the route monitoring display covering own ship's position immediately by single operator action. (See 6.9.3.)*

4.10.5.3 *ECDIS shall give an alarm if the ship, within a specified time set by the mariner, is going to cross the safety contour. (See 6.9.3.)*

4.10.5.4 *ECDIS shall give an alarm or indication, as selected by the mariner, if the ship, within a specified time set by the mariner, is going to cross the boundary of a prohibited area or of a geographic area for which special conditions exist. (See annex C.) (See 6.9.3.)*

4.10.5.5 *An alarm shall be given when the specified limit for deviation from the planned route is exceeded. (See 6.9.3.)*

Route monitoring will only provide an automatic alarm if the mariner has entered the appropriate data in 4.10.4.6.

4.10.5.6 *The ship's position shall be derived from a continuous positioning system of an accuracy consistent with the requirements of safe navigation. Whenever possible, a second independent positioning method of a different type shall be provided; ECDIS shall be capable of identifying discrepancies between the two systems. (See 6.8.12.)*

The ECDIS shall have means to display the position from at least two positioning methods, to identify which method is being used, and provide a means for the operator to select the method he wants to use. Secondary positioning methods could include dead reckoning.

4.10.5.7 *ECDIS shall provide an alarm when the input from the position-fixing system is lost. ECDIS shall also repeat, but only as an indication, any alarm or indication passed to it from a position-fixing system. (See 6.8.12.)*

4.10.5.8 *An alarm shall be given by ECDIS if the ship, within a specified time or distance set by the mariner, is going to reach a critical point on the planned route. (See 6.9.3.)*

ECDIS shall permit the mariner to define critical points and the time or distance at which an alarm shall be given. The words "to reach a critical point" shall be considered passing abeam of the critical point on the planned route.

4.10.5.9 *The positioning system and the SENC shall be on the same geodetic datum. ECDIS shall give an alarm if this is not the case. (See 6.8.12.)*

4.10.5.10 *It shall be possible to display an alternate route in addition to the selected route. The selected route shall be clearly distinguishable from the other routes. During the voyage, it shall be possible for the mariner to modify the selected route or select an alternate route. (See 6.9.3.)*

4.10.5.11 *It shall be possible to display:*

- .1 time-labels along ship's track manually on demand and automatically at intervals selected between 1 and 120 minutes; and (See 6.9.3.)*
- .2 an adequate number of: points, free movable electronic bearing lines (EBL), variable range markers (VRM), fixed range markers and other symbols required for navigation purposes and specified in annex B. (See 6.8.11.)*

An "adequate number" of EBL and VRM implies at least one of each.

4.10.5.12 *It shall be possible to enter the geographic coordinates of any position and then display that position on demand. It shall also be possible to select any point (feature, symbol or position) on the display and read its geographic co-ordinates on demand. (See 6.8.10.)*

4.10.5.13 *It shall be possible to adjust the ship's geographic position manually. This manual adjustment shall be noted alpha-numerically on the screen, maintained until altered by the mariner, and automatically recorded. (See 6.8.12 and 6.9.4.)*

4.10.6 Voyage recording

4.10.6.1 *ECDIS shall store and be able to reproduce certain minimum elements required to reconstruct the navigation and verify the official database used during the previous 12 hours. The following data shall be recorded at one minute intervals: (See 6.9.4.)*

- .1 to ensure a record of own ship's past track: time, position, heading and speed; and*
- .2 to ensure a record of official data used: ENC source, edition, date, cell and update history.*

4.10.6.2 *In addition, ECDIS shall record the complete track for the entire voyage, with time marks at intervals not exceeding 4 hours. (See 6.9.5.)*

For the purposes of logging, the entire voyage is defined as a maximum period of three months.

4.10.6.3 *It shall not be possible to manipulate or change the recorded information. (See 6.9.4.)*

4.10.6.4 *ECDIS shall have a capability to preserve the record of the previous 12 hours and of the voyage track. (See 6.9.5.)*

4.11 Accuracy

4.11.1 *The accuracy of all calculations performed by ECDIS shall be independent of the characteristics of the output device and shall be consistent with the SENC accuracy. (See 6.6.)*

The output device includes ECDIS display, stored memory, and/or printout.

4.11.2 *Bearings and distances drawn on the display, or those measured between features already drawn on the display, shall have an accuracy consistent with the resolution of the display but no more than that afforded by the compilation scale of the SENC. (See 6.6.)*

4.12 Connections with other equipment (Interfaces)

(See IEC 61162 series.)

4.12.1 *ECDIS shall not degrade the performance of any equipment providing sensor inputs. Nor shall the connection of optional equipment degrade the performance of ECDIS below this standard. (See 6.2.)*

4.12.2 *ECDIS shall be connected to systems providing continuous position fixing, heading and speed information. (See 6.2.)*

4.13 Performance tests, malfunction alarms and indications

4.13.1 *ECDIS shall be provided with means for carrying out on-board tests of major functions either automatically or manually. In case of a failure, the test shall display information to indicate which module is at fault. (See 6.8.17.)*

On board tests of major functions include the integrity of sensor input. If there is any detectable reason why the information presented to the operator is invalid, adequate and clear warnings shall be given to the operator. This clarification is consistent with annex 4 to IMO resolution MSC.64.

4.13.2 *ECDIS shall provide suitable alarm or indication of system malfunction. (See 6.8.17.)*

4.14 Back-up arrangements

Adequate independent back-up arrangements shall be provided to ensure safe navigation in case of an ECDIS failure: (See annex G.)

- .1 Facilities enabling a safe take-over of the ECDIS functions shall be provided in order to ensure that an ECDIS failure does not result in a critical situation.*
- .2 A back-up arrangement shall be provided facilitating means for safe navigation of the remaining part of the voyage in case of an ECDIS failure.*

4.15 Power supply

4.15.1 *It shall be possible to operate ECDIS and all equipment necessary for its normal functioning when supplied by an emergency source of electrical power in accordance with the appropriate requirements of regulation II/1 of the 1974 SOLAS convention.*

4.15.2 *Changing from one source of power supply to another, or any interruption of the supply for a period of up to 45 seconds, shall not require the equipment to be re-initialized manually. (See 6.9.6.)*

The equipment is not required to remain operational during this interruption of the power supply.

5 Requirements contained in IHO special publications

5.1 Content and structure of chart data

The chart data shall be delivered using the IHO transfer standard for digital hydrographic data (S-57). (S-52/3.1(a))

Any ECDIS shall be capable of accepting and converting official HO data (ENC) to the internal storage structure of the individual ECDIS (system ENC or SENC). Such data includes both that in the ENC and that delivered in digital format to update the ENC. (S-52/ 3.3(b)) (See 6.8.15.1.)

The transfer standard, is designed for the distribution of digital chart data. It is recognized that it is not the most efficient means of storing, manipulating or preparing data for display. Each manufacturer of ECDIS systems may design his own storage formats or data structure to allow its system to meet the performance requirements stated in S-52. The resulting database is called the system ENC (SENC). (S-52/3.3(a))

The following restrictions also apply:

- .1 The precision of HO supplied data shall be maintained, e.g. HO data provided in degrees and decimal degrees, when converted to manufacturer specific formats and structures and used in calculations, shall also be maintained to that accuracy. (S-52/3.4(b)(1)) (See 6.6.)*

- .2 *Should the manufacturer use point reduction or smoothing operations in order to compress the chart information in the SENC, the resultant image of the chart displayed at ENC scale shall not differ from the ENC image by more than the display resolution. (S-52/3.4(b)(2)) (See 6.6.)*
- .3 *HO data will be supplied in a cell structure. (See S-52/3.6.) If this cell structure is modified, it is the ECDIS manufacturer's responsibility to maintain cell dependent characteristics. (S-52/3.4(b)(3)) (See 6.5 and 6.8.15.1.)*

5.2 Priority of chart display

Layers are required to establish the priority of data on the display. The general rule for the priority between different categories of information is given below: (S-52/5.3(a)) (See 6.8.3 and 6.8.4.)

- .1 *ECDIS visual alarms/indications (e.g. caution, overscale);*
- .2 *HO-data: points/lines and areas plus official updates;*
- .3 *Notices to mariners, manual input and radio navigational warnings;*
- .4 *HO-caution (ENC cautions);*
- .5 *HO-colour-fill area data;*
- .6 *HO's on demand data;*
- .7 *radar information;*
- .8 *mariners data: points/lines and areas;*
- .9 *manufacturer's data: points/lines and areas;*
- .10 *mariners colour-fill area data.*

NOTE 1 – *This list is not intended to indicate a drawing sequence, but to specify that the information content of category n+1 must not obscure the information content of category n or any higher category (i.e. n-1, etc.). (S-52/5.3(b)(1)) (See S-52 appendix 2/2.3.2 a.)*

NOTE 2 – *Category .7 shall have a radar off switch to facilitate its removal. In order to meet the requirements of 4.6.3.4 to adjust ship's position, the ECDIS may incorporate the capability of changing the radar priority of the presentation library. Operation of this feature shall be clearly indicated. (S-52/5.3(b)(2)) (See S-52 appendix 2/2.3.2 b.) (See 6.8.13.)*

5.3 Display of chart information

5.3.1 Scale and navigation purpose

If data from different compilation scales appears on the display, the boundary between different scales shall be clearly indicated. (S-52/6.3(a)) (See 6.8.6.)

When the display cannot be completely covered with ENC data for the selected navigational purpose, the remaining part of the display shall be filled with data based on a more general navigational purpose (if available). (S-52/6.3(b)) (See 6.8.6.)

A graphical index of the navigational purpose of available data shall be shown on demand. (S-52/6.3(c)) (See 6.8.6.)

Data shown on the display shall always be of the same display scale. If a compilation scale boundary is shown on the display, the information shown in the overscale area shall not be relied upon at the scale of the display. The overscale area shall be identified as specified in S-52 appendix 2. (Note that this overscale identification only applies to automatic area scaling of parts of the display; it does not apply to overscaling of the entire display commanded by the mariner.) (S-52/3.5(d))

The manufacturer shall give the navigator the ability to use intermediate display scales, or zoom in between scales. (S-52/6.3(e)) (See 6.8.6.)

A scale bar shall be provided as part of the display base for navigating on a large compilation scale (1:80 000 and larger). (S-52/6.3(g)) (See S-52 appendix 2/ 3.2.3.9(a).) (See 6.8.6.)

For chart displays at a compilation scale smaller than 1:80 000, a latitude bar shall be shown on the border of the standard display. (S-52/6.3(g)) (See S-52 appendix 2 /3.2.3.9 (b).) (See 6.8.6.)

5.3.2 Text

The text on the ECDIS shall be readable from 1 metre. Sans serif, non-italic fonts shall be employed. The computer "Ø" shall not be used. (S-52 appendix 2/(3.1.5)) (See S-52 appendix 2/3.4.1 and IEC 60945.) (See 6.7.1.)

Similar fonts may be used as long as clarity is not reduced.

5.3.3 Units and legend

Units to be used on ECDIS displays: (S-52/6.4(a))

.1	Position	latitude and longitude in degrees, minutes and decimal minutes;
.2	Depth	metres and decimetres;
.3	Height	metres;
.4	Distance	nautical miles and decimal nautical miles, or metres;
.5	Speed	knots and decimal knots.
.6	Time	hours, minutes and seconds;
.7	Direction	degrees and tenths of degrees.

Units used shall be indicated in the display legend. There shall be no ambiguity about the units in use at a particular time. (S-52/6.4(b)) (See 6.7.2.)

A standard legend of general information relating to the area displayed, applicable to the ship's position, shall be shown on a graphic or text display. This legend shall contain as a minimum: (S-52/6.5) (See 6.7.2.)

- .1 units for depth;
- .2 units for height;
- .3 scale of display;
- .4 data quality indicator;
- .5 sounding/vertical datum;
- .6 horizontal datum;
- .7 the value of the safety depth if used;
- .8 the value of the safety contour;
- .9 magnetic variation;
- .10 date and number of last update affecting the chart cells currently in use;
- .11 edition number and date of issue of the ENC;
- .12 chart projection.

5.4 Display functions

5.4.1 Object information

It shall be possible to call up all the information associated with an object by cursor enquiry on its symbol. This shall extend to areas (restricted area, depth area, etc.) and to "no symbol" areas (territorial seas, etc.) and meta areas (information about the area such as compilation

scale, etc.). The search for area information shall extend only to the cell boundaries enclosing the cursor. (S-52 appendix 2/3.1.9) (See 6.8.10.)

By identifying any object (point, line or area) with a cursor on the chart display, the object description and all available attributes shall be displayed in text in common language terms. (S-52/3.1(d)) (See 6.8.10.)

Text shall not appear automatically whenever the object it is associated with appears on the display. It shall always be possible to remove text independently of the object. (S-52 appendix 2/2.3.3(c)) (See 6.8.10.)

5.4.2 Navigational information

If the ECDIS offers a ship-centred display mode, the manufacturer shall avoid overwriting between the ship symbol and a centred symbol for an area which wholly encloses the display (for example the traffic direction arrow (TSSLPT) in a very large traffic lane such as Dover Strait). (S-52 appendix 2/3.1.2.1.6(d)) (See 6.8.7.)

This can be accomplished by moving the "centred" symbol. When the "centred" symbol is visible beneath the ship symbol, movement is not required.

5.4.3 Safety contour

If the mariner does not specify a safety contour, this shall default to 30 m. If the safety contour specified by the mariner is not in the SENC, the safety contour shown shall default to the next deeper contour. (S-52/3.4(c) and S-52 appendix 2/3.2.2(1)) (See 6.8.8.)

If the safety contour in use becomes unavailable due to a change in source data, the safety contour shall default to the next deeper contour. In each of the above cases, the mariner shall be informed. (S-52/3.4(c) and S-52 appendix 2/3.2.2(1)). (See 6.9.2 and 6.9.3.)

At all times, the safety contour shall be the one specified by the mariner or the next deeper contour if the specified one is not available. At a minimum the mariner shall be informed by emphasizing the new safety contour.

5.4.4 Navigational calculations

The system shall be capable of performing at least the following calculations: (S-52/7.1(a)) (See 6.6.)

- .1 geographic co-ordinates to display co-ordinates and vice versa;*
- .2 transformation between local datum and WGS-84; (See S-52/6.1(c).)*
- .3 true distance and azimuth between two geographic positions;*
- .4 geographic position from known position and distance/azimuth;*
- .5 projection calculations such as true distance, rhumb line, convergence and great circle.*

The accuracy of these calculations shall be such that there shall be no visible distortion on the display between the following: (S-52/7.1(b)) (See 6.6.)

- .1 rhumb line and chart data;*
- .2 great circle and chart data.*

5.5 Supplementary display functions

5.5.1 Additional mariner's information

The mariner shall be provided with the capability of adding at least the following symbols, lines and areas to the SENC, and shall be able to revise or delete them: (S-52 appendix 2/2.3.1(b)) (See 6.8.5.)

- .1 the caution (!) or information (i) symbol used to call up a note on the text display by cursor picking; (See S-52 appendix 2/3.2.3(6).)*
- .2 simple lines and areas with or without colour fill, set up for cursor picking to give explanatory note in the text display;*
- .3 any of the symbols in the presentation library;*
- .4 text notes.*

In addition to the Presentation Library, other symbols may be used.

5.5.2 Additional non-HO information

Additional information from non-HO sources, may be displayed provided this does not degrade the display of ENC data. This additional information shall be distinguished from the ENC data. (S-52/7.2(f)) (See S-52 appendix 2.) (See 6.5.2 and 6.8.5.)

If the area covered by the ECDIS display includes waters for which no HO ENC at a scale appropriate for navigation exists, the areas representing those waters shall carry an indication to the mariner to refer to the paper chart. (S-52/3.4(a)) (See 6.5.2 and S-52 appendix 2.)

An area with no chart data of any kind shall be marked with the “no data” symbology defined in the presentation library. (See S-52 appendix 2/3.2.3(14).) (See 6.5.2.)

If an area with no ENC data (see 4.2.2) is covered by non-ENC data, the area shall be marked by the “non-ENC area” symbology defined in the presentation library. (See S-52 appendix 2/3.2.3(13a) and (13b).) (See 6.5.2.)

Should an “unknown object” occur in the SENC which is not adequately defined or for which no symbol exists, its presence shall be indicated on the display by a magenta “?” with the IMO category “Standard Display”. (S-52 appendix 2/3.1.3) (See 6.5.1.)

5.5.3 Tidal adjustment

Depth information shall only be displayed as it has been provided in the ENC and not adjusted by tidal height. (S-52/7.2(g)) (See 6.8.5.)

5.6 Use of the presentation library

The library version number is included in the presentation library, and it shall be possible to display it on the ECDIS. (S-52 appendix 2/1.2.3) (See 6.5.1.)

The presentation library includes an ECDIS chart 1 showing both simplified and full chart symbols and their explanations. The ECDIS shall provide linking by cursor interrogation between the symbols and the explanations. (S-52 appendix 2/3.1.4) (See 6.5.1.)

This is valid for both the IHO presentation library and one provided by a manufacturer.

The presentation library contains colour differentiation test diagrams to enable the mariner to detect the stage at which the display can no longer be used to discriminate important features by colour. These diagrams, one for each colour table, are coded in S57 format. The ECDIS shall allow the selection and display of these test diagrams. The diagrams shall be used to check the discriminability of colours within all of the tables except day-bright. (S-52 appendix 2/5.2.5) (See 6.7.3.)

5.7 Display characteristics

Information shall be displayed in the ECDIS on one or more physical screens, which may be divided into more than one display. Information may be displayed automatically, on demand or as a result of hand-entry. In addition to the IMO performance standards the following rules apply: (S-52/7.2)

The units for depth shall always be on the same screen as the chart display. (S-52/7.2(a)) (See 6.8.2.)

The following information shall be visible on demand on the same screen as the chart display is visual or on an additional graphic or text display: (S-52/7.2(b)) (See 6.8.2.)

- .1 positional data and time;*
- .2 legend;*
- .3 object description and associated attributes (result of "cursor query");*
- .4 textual information from SENC;*
- .5 list of abbreviations (from INT-1);*
- .6 result from navigational computations;*
- .7 record of ENC-updates;*
- .8 list of categories which are removed from standard display;*
- .9 symbol library. (See S-52 appendix 2)*

Navigators notes shall be visible as a result of a hand-entry on the same screen as the chart display or on an additional graphic or text display. (S-52/7.2(c)) (See 6.8.5.)

5.8 Performance requirements

5.8.1 Redraw

The ECDIS shall:

Redraw during route monitoring to follow the ship's progress, including scale changes due to change in the scale of the chart information, shall take less than 5 seconds. Demands by the mariner that cannot be predicted by the ECDIS, such as draw at a different scale or in a different area may take more than 5 seconds. In the latter case: (S-52/8(a))

- the mariner shall be informed;*
- the display shall continue route monitoring until the new information is ready to draw within 5 seconds.*

If there is a delay in preparing (re-generating) data for display (e.g. due to a request for scale change or look ahead to another area) the ECDIS shall inform the mariner. The previous display shall be maintained and updated, until the new display is ready for re-draw. (S-52 appendix 2/2.2.3) (See 6.9.3.)

5.8.2 Resolution

Minimum lines per mm (L) given by $L = 864/s$, where s is the smaller dimension of the chart display area (e.g. for the minimum chart area, $s = 270$ mm and the resolution is $L = 3,20$ lines per mm, giving a "picture unit" size of 0,312 mm). (S-52/8.(c)) (See 6.7.4.)

The minimum sizes for all symbols shall be as shown in the presentation library. (S-52 appendix 2/3.1.5) (See 6.7.1.)

In addition, the symbols shall always be drawn with at least the same number of pixels as are required to draw the symbol at the size defined in the presentation library for the minimum

resolution and minimum chart display area (270 × 270 mm). (S-52 appendix 2/3.1.5) (See 6.7.1.)

5.8.3 Number of colours

Colours: 64 (S-52/8.(c)) (See 6.7.3.)

5.8.4 Brightness and contrast

The brightness and contrast controls shall have a provision to permit returning to the calibrated setting. The ECDIS manual shall carry a warning that use of the brightness control may inhibit visibility of information at night. (S-52 appendix 2/4.1.4) (See 6.7.3.)

The colour tables are provided in the presentation library, all of which shall be available. (S-52 appendix 2/4.1.5) (See 6.7.3.)

Colour tolerance values:

- .1 the discrimination difference between any two colours displayed shall be not less than 10 ΔE^* units; (S-52 appendix 2/5.2.3.1)*
- .2 the difference between the colour displayed and the CIE colour defined in the specification shall be not greater than 16 ΔC^* units. If a monitor is independently tested, then the difference shall not be greater than 8 ΔC^* units; (S-52 appendix 2/5.2.3.1)*
- .3 the luminance of the colour displayed shall be within 20 % of its specified value. Black is a special case and the luminance of it shall be not greater than 0.52 cd/m² for DAY_BRIGHT. (S-52 appendix 2/5.2.3.1) (See 6.7.3.)*

For the bright-sun colour table, restricted to colour pairs of tabular ΔE^* greater than 20. (S-52 appendix 2/5.2.3.2)

If an optical filter is used with colour table night-filtered, it shall be removable, and of the value 0,9 ND. (S-52 appendix 2/4.1.2) (See S-52 appendix 2/4.1.5.)

5.9 Ergonomic requirements

The ECDIS shall provide the mariner with the option of using either the traditional paper chart symbols or the new simplified symbols as best fits his purpose. (S-52 appendix 2/3.2.1(2)) (See 6.7.1.)

The north arrow shall always be shown at the top left corner of the chart display, just clear of the scale bar or the latitude scale. (S-52 appendix 2/3.2.3(10)) (See 6.8.7.)

Any windows containing text, diagrams, etc. superimposed on the route monitoring display shall be temporary. (S-52 appendix 2/3.4.2) (See 6.7.5.)

Temporary for this application means that the window can be moved or removed from the display.

It shall be possible to re-locate such windows in a less important part of the display, such as on land, or behind the own ship symbol. (S-52 appendix 2/3.4.2) (See 6.7.5.)

A mariner's information panel on the same screen as the route monitoring display shall use only the "user interface" colours from the presentation library colour tables. (S-52 appendix 2/3.4.3) (See 6.7.5.)

A mariner's information panel may use clearly visible colours which do not detract from the chart display in any of the five mandatory colour tables. (See S-52 appendix 2/4.1.5.)

5.10 Update of chart information

5.10.1 General

Test requirements are addressed to individual update sets or cumulative updates (collection of sequential individual update sets). A third alternative update method is the “compilation update” set, which contains all current changes from the edition date of the ENC, and does not involve or rely on any previously issued update.

It shall be possible to carry out updating operations in all ECDIS modes, e.g. route planning, route monitoring, etc.

The detailed method of updating is described in the ENC product specification in S-57. If, in the following clauses, there are conflicts between the requirements of S-52 appendix 1 and the ENC product specification, the requirements of the latter shall be used.

5.10.1.1 Integration of updates

Updates shall be clearly distinguishable on the display. Once accepted, integrated updates shall be indistinguishable from ENC data. (S-52 appendix 1/3.4.1(c)) (See 6.8.15.2.)

Non-integrated updates (e.g. those entered manually) shall be distinguishable as described in S-52 appendix 2/2.3.4.

Official HO updates shall be distinguished from local ones. (S-52/4.(a)) (See 6.8.15.2.)

5.10.1.2 Recall for display

It shall be possible on demand to review a previously installed update. (S-52 appendix 1/3.4.1(e)) (See 6.8.15.2 and 6.8.16.)

5.10.1.3 Log file

ECDIS shall keep a record of updates, including time of application and identification parameters described in S-52 appendix 1/3.2(i), through a log file. The log file shall contain, for each update applied to or rejected by the SENC, the following information: (S-52 appendix 1/3.4.1(h)) (see 6.8.15.3)

- .1 date and time of application/rejection;*
- .2 complete and unique identification number of update as described in the S-57 product specification;*
- .3 any anomalies encountered during application;*
- .4 type of application: manual/automatic.*

An example of “anomalies” could be error messages or load warnings.

5.10.1.4 Update applied out of sequence

The ECDIS shall warn the user when an update is out of sequence, terminate the update and restore the SENC as it was before application of the ENC update file. (S-52 appendix 1/3.4.1(i)) (See 6.8.15.1.)

5.10.2 Manual update

5.10.2.1 Keying and symbology

The ECDIS shall enable manual entry of updates for non-integrated presentation on the display. A capacity shall exist to enable the mariner to: (S-52 appendix 1/3.4.3(a)) (See 6.8.16)

- .1 enter the update as described in S-52 appendix 2;*

- .2 *ensure all update text information relevant to the new condition and to the source of the update is entered by the mariner and recorded by the system, for display on demand.*

The system shall be capable of implementing manual updates to point objects and simple line and area objects such as traffic routing schemes and restricted areas, but excluding complicated lines and areas such as contours and coastlines.

5.10.2.2 Indications and alarms

The ECDIS shall be capable of sensing indications and alarms related to non-integrated (manual) updates, just as it does for integrated ENC updates. (S-52 appendix 1/3.4.3(b)) (See 6.8.16.)

5.10.2.3 Presentation

Manual updates shall be displayed as described in S-52 appendix 2/2.3.4. (S-52 appendix 1/3.4.3) (See 6.8.16.)

It shall be possible to remove from the display any manual update. The removed update shall be retained in the ECDIS for future review until the commencement of the next voyage, but will not be otherwise displayed. (S-52 appendix 1/3.4.3(e)) (See 6.8.16.)

Manual updates only need to be retained until a new edition of the cell is incorporated.

For the purpose of retaining the removed updates in the ECDIS for future review, the commencement of the next voyage is defined as a period of three months.

5.10.3 Semi-automatic update

The ECDIS shall be capable of receiving updates in standard IHO format by 3,5 inch high density diskette or equivalent suitable portable media and through a telephone network. (S-52 appendix 1/3.4.2(a(ii))) (See 6.8.15.1.)

5.10.4 Reception of updates

The identification of the issuing authority of the update shall be checked for conformance with the corresponding identifier of the ENC. (S-52 appendix 1/3.4.2(b(ii))) (See 6.8.15.1.)

If any errors are detected from the receiving device, the reception procedure shall be terminated and the ENC update flagged invalid in the record of updates. The user shall be informed of the corruption.

The ECDIS shall employ the error detection scheme defined by IHO for ENC data.

The ECDIS shall reject corrupted files and provide a warning of this action.

5.10.5 Sequence check

The following sequence number checks shall be performed at the time of application, for sequential and cumulative updates: (S-52 appendix 1/3.4.2(c)) (See 6.8.15.3)

- .1 *file extension of the ENC update;*
- .2 *number of the ENC update;*
- .3 *sequence number of the individual records in the ENC update.*

Refer to the S-57 product specification for details on how these sequence numbers are encoded in the ENC update.

5.10.6 Consistency check

The mariner shall be warned of any previous ENC updates which have not been successfully applied. (S-52 appendix 1/3.4.2(d)) (See 6.8.15.1.)

5.10.7 Geographic applicability

Updates not relating to a cell within a set of ENCs in the ECDIS may be discarded. (S-52 appendix 1/3.4.2(e)) (See 6.8.15.2.)

5.10.8 Summary report

A summary report for each of the issuing authority's official update files shall be given after completion of receipt containing at least: (S-52 appendix 1/3.4.2(f)) (See 6.8.15.3)

- .1 identification of issuing authority;*
- .2 update numbers of the update files;*
- .3 cell identifiers of cells affected;*
- .4 edition number and date of cell involved;*
- .5 number of updates in the affected cells.*

5.10.9 Review of ENC updates

It shall be possible for the mariner to review the updates applied through displaying the SENC contents with the updates highlighted. (S-52 appendix 1/3.4.2(g)) (See 6.8.15.2.)

5.10.10 Modification of updates

Rejection or amendment of an update by the mariner shall be achieved by the manual update method. The questionable update shall be noted as an anomaly in the log file. (S-52 appendix 1/3.4.2(h)) (See S-52 appendix 1/3.4.1(h))

6 Methods of testing and required test results

6.1 EUT installation and technical documentation

The equipment under test (EUT) shall be installed in compliance with the manufacturer's installation manual.

Where equipment is divided (e.g. route planning on one display and route monitoring on the other), the entire configuration shall be tested together.

The manufacturer shall provide sufficient information and documentation for the equipment to be understood and operated.

6.2 Interfaces

(4.6.3.1 / 4.12)

During testing, specified digital signals shall input into the EUT to emulate the position, heading and speed over ground of the own ship. Signals may also be provided as necessary to represent radar returns appropriate to the equipment and the position of the ship. Tests shall be performed using a simulator or at sea.

- a) Signals carrying positional data shall conform to IEC 61162 series and the appropriate EPFS standard.
- b) Signals carrying heading information shall conform to IMO resolutions A.424 and A.821; any digital output shall conform to IEC 61162 series.

- c) Signals carrying speed information shall conform to IMO resolution A.824; any digital output shall conform to IEC 61162 series.
- d) Simulated ARPA signals may be provided by the supplier, and shall conform to IMO resolution A.823; any digital output shall conform to IEC 61162 series.
- e) Simulated or real radar signals in accordance with annex 4 to IMO resolution MSC.64 may be provided.

An IEC 61162 series interface simulator shall be connected. Messages shall be sent and received.

6.3 Environmental

All the general requirements of IEC 60945 appropriate to its category, i.e. “protected”, shall be carried out. The manufacturer shall declare any preconditioning required before environmental checks. For the purposes of this standard the following definitions for “performance check” and “performance test”, required by IEC 60945, shall apply:

Performance check	Reconfigure the EUT and check by non-quantitative visual checks that the system is still operative;
Performance test	For the purposes of IEC 60945 the “performance test” for EUT shall be identical to the “performance check”.

6.4 Preparation

6.4.1 Power-up

The installed EUT shall be powered up in accordance with the manufacturer’s recommended procedures. Any self-testing shall be completed using simulated inputs. Signal generators shall be activated in a coherent manner to represent a stationary ship at the position selected. All the necessary selections to configure the equipment for the test environment shall be undertaken in accordance with the manufacturer’s recommendations and settings.

6.4.2 Initial ship parameters

The following parameters shall be entered into the EUT for a simulated test:

Ship length	300 m
Ship beam	30 m
Ship draught	7 m
Conning position	
Aft of ship centre	100 m
On centre line	
Navigation receiver antenna	
Forward of conning position	5 m
Starboard of centre line	10 m
Secondary navigation receiver antenna (if provided to meet 4.10.5.6)	
Forward of conning position	5 m
Port of centre line	10 m
Radar antenna:	
Forward of conning position	7 m
On centre line	

The navigation receiver antenna offset shall be varied and it shall be confirmed that the position on the EUT changes accordingly.

6.4.3 Required test items (4.4.1 / 4.4.2 / 5.1)

For the purpose of these tests the following items shall be used:

- IHO ECDIS presentation library contained in S-52 appendix 2 including an ECDIS chart 1 and colour differentiation diagrams. If the manufacturer provides his own presentation library, Chart 1 has to be adapted accordingly;
- IHO test data set for IEC 61174 which includes ENC data and its updates, together with the associated instruction manual. The contents of this test data set are described in annex F.

6.5 Initial data tests

6.5.1 Presentation library (4.3.1 / 5.5.2 / 5.6)

- a) Check that the edition number of the presentation library can be displayed. Observe the chart display and check that the buoy symbols are as defined in the presentation library.
- b) Check that ECDIS chart 1, contained in the presentation library, can be displayed. Select three symbols and check that these symbols can be interrogated by cursor and that the associated text explanation contained in the symbol library of the presentation library is displayed.
- c) Load an ENC containing an object not valid for ENC purpose, i.e. an object, attribute and attribute value not recognized by the presentation library. Check that the symbol magenta “?” occurs at the indicated position on the test chart when the standard display is selected. Check that display of the symbol can be disabled.
- d) Check that the EUT provides the capability to select for display either the simplified chart symbols for buoys and beacons, special areas, etc., or the corresponding paper chart symbols.

6.5.2 ENC (4.4.1 / 4.4.2 / 5.5.2)

Check that the edition number and date of the ENC included in the IHO test data set for IEC 61174 is displayed in the chart library.

Load an additional ENC cell and ensure that the chart coverage has changed and that the chart library is updated.

Remove an ENC cell and ensure that the chart coverage has changed and that the chart library is updated.

- a) Load a data cell whose source identification indicates that the data is non-official (by the inclusion of a producer code, which indicates a source other than the official producers listed in the annex A to S-57 appendix A). Check that when the area of this cell is displayed, the boundary of the area, or the edge of the display if the boundary is off-screen, is marked using the appropriate symbology as defined in the presentation library. The warning “No official data available. Refer to paper chart” shall appear.
- b) Select a display area for part of which no ENC data is loaded and check that the “no data” area symbolization defined in the presentation library is displayed in the appropriate area.

6.6 Accuracy

(4.11.1 / 4.12.1 / 5.1 / 5.4.4)

The test shall verify:

- the accuracy of EUT calculations consistent with SENC;
 - the measurement accuracy consistent with display resolution.
- a) Perform the measurements provided for in the IHO test data set and confirm that they meet the required accuracy. Check that the system can perform the following calculations:
 - transformation between a local datum and WGS-84;

- true distance and azimuth between two geographical positions;
 - geographic position from known position and distance/azimuth;
 - rhumb line and great circle.
- b) Calculate and display both a rhumb line and a great circle line according to test scenario 1 of annex J and verify that no visible distortion exists between these lines and the chart data.

This test shall be carried out using the scale supported by the data, i.e. not over-scaled.

6.7 Visual requirements

6.7.1 Symbols (4.8.1 to 4.8.4 / 5.3.3 / 5.9)

- a) Check that the symbols and navigational elements conform to the IHO presentation library.
- b) Display simplified symbols. Check that the simplified symbols conform to the IHO presentation library.
- c) Perform zoom-in and zoom-out operations in each mode and check that the symbols do not decrease in size below that shown in the IHO presentation library.
- d) Check that it is possible to display own ship in true scale or as a symbol.
- e) Display “Buoys and Beacons (Q)” part of the ECDIS Chart 1 (cell name AA5C1Q00). Check that the height of the CHKSYM01 symbol is not less than 5 mm.
- f) Check that the number of pixels (lines) which comprise the vertical extent of the symbol CHKSYM01 is not less than 16.
- g) Using a sample of text, check that the height of upper-case characters is not less than 3,5 mm.

6.7.2 Units and legend (5.3.3)

- a) Check that units are as follows:
 - .1 Position latitude and longitude in degrees, minutes and decimal minutes;
 - .2 Depth metres and decimetres;
 - .3 Height metres;
 - .4 Distance nautical miles and decimal nautical miles, or metres;
 - .5 Speed knots and decimal knots;
 - .6 Time hours, minutes and seconds;
 - .7 Direction degrees and tenths of degrees.
- b) Check that the following elements are available in the display of general information:
 - .1 units for depth;
 - .2 units for height;
 - .3 scale of display;
 - .4 data quality indicator;
 - .5 sounding/vertical datum;
 - .6 horizontal datum;
 - .7 the value of the safety depth;
 - .8 the value of the safety contour;
 - .9 magnetic variation;
 - .10 date and number of last update affecting the chart cells currently in use;
 - .11 edition number and date of issue of the ENC;
 - .12 chart projection.

6.7.3 Colour table (4.8.1 to 4.8.2 / 4.9.3 / 5.6 / 5.8.3 / 5.8.4)

Manufacturers can choose between two different methods of color calibration. The first method is a test of a monitor as part of an integrated system. The second method is an independent test of a monitor.

6.7.3.1 Integrated system

- a) Calibration verification shall be carried out under normal conditions as defined in IEC 60945. Check that for selected colours in the bright-sun colour table of the presentation library, the colours displayed shall agree with the colours in the presentation library within the tolerances given in 5.8.4. The test shall be performed as follows:
 - 1) Select totally black screen provided by the manufacturer. Check that the level of the black is as required (less or equal than 0.52 cd/m^2)
 - 2) Select screen provided by the manufacturer, which has in a black background a box of CHWHT (brightest white). The size of box is at least 5 cm per side but not more than 25 % of the total screen area. Check that the level of CHWHT is within the tolerances of ΔC^* (not greater than 16 units of ΔC^*) and ΔL^* (be within 20 % of its specified value)
 - 3) Select screen provided by the manufacturer, which has in a black background a box of CHMGF (brightest magenta). The size of box is at least 5 cm per side but not more than 25 % of the total screen area. Check that the level of CHMGF is within the tolerances of ΔC^* (not greater than 16 units of ΔC^*) and ΔL^* (be within 20 % of its specified value)
 - 4) Select screen provided by the manufacturer, which has in a black background a box of CHYLW (brightest yellow). The size of box is at least 5 cm per side but not more than 25 % of the total screen area. Check that the level of CHYLW is within the tolerances of ΔC^* (not greater than 16 units of ΔC^*) and ΔL^* (be within 20 % of its specified value)
 - 5) Select screen provided by the manufacturer, which has in a black background a box of BKAJ2 (darkest grey). The size of box is at least 5 cm per side but not more than 25 % of the total screen area. Check that the level of BKAJ2 is within the tolerances of ΔC^* (not greater than 16 units of ΔC^*) and ΔL^* (be within 20 % of its specified value)
- b) The day-black-background, dusk, and night tables shall be tested as follows.
 - 1) The person conducting the test shall have passed the Ishihara colour blindness test taken by mariners and shall adapt to night viewing for 10 min before checking the night display.
 - 2) The brightness and contrast controls shall be set to their calibrated settings.
 - 3) While the display is off, adjust the light level reflected from white paper positioned on the display screen to the following values in table 1.

Table 1 – Light levels

Time period	Light level
Day-black-background	$200 \text{ cd/m}^2 \pm 50 \%$
Dusk	$10 \text{ cd/m}^2 \pm 50 \%$
Night	Darkness (ECDIS display predominant light)

Preferably use natural daylight for the two daytime tables.

- 4) Under each of the above conditions display the appropriate colour differentiation test diagrams described in S-52 appendix 2, annex A, part 3, section 4.1 for the above tables. Select each table in turn and ensure that:
 - each foreground stripe is clearly distinguished from its background;
 - the foreground stripes representing yellow, orange, magenta, green, blue and grey may be clearly identified.
- 5) Under each of the above conditions display the black adjust boxes available from ECDIS chart 1 (the chart AA5C1ABO of ECDIS chart 1). Select each table in turn and ensure that:

- symbol BLKADJ01 is clearly distinguished from its background

6.7.3.2 Independent monitor

- a) Calibration verification shall be carried out under normal conditions as defined in IEC 60945. Check that for selected colours in the bright-sun colour table of the presentation library, the colours displayed shall agree with the colours in the presentation library within the tolerances given in 5.8.4. The test shall be performed as follows:
 - 1) If you check a monitor then use a reference computer, which is provided by the manufacturer of the monitor. If you check a computer then use a reference monitor, which is provided by the manufacturer of the computer.
 - 2) Select totally black screen provided by the manufacturer. Check that the level of the black is as required (less or equal than 0.52 cd/m^2)
 - 3) Select screen provided by the manufacturer, which has in a black background a box of CHWHT (brightest white). The size of box is at least 5 cm per side but not more than 25 % of the total screen area. Check that the level of CHWHT is within the tolerances of ΔC^* (not greater than 8 units of ΔC^*) and ΔL^* (be within 20 % of its specified value)
 - 4) Select screen provided by the manufacturer, which has in a black background a box of CHMGF (brightest magenta). The size of box is at least 5 cm per side but not more than 25 % of the total screen area. Check that the level of CHMGF is within the tolerances of ΔC^* (not greater than 8 units of ΔC^*) and ΔL^* (be within 20 % of its specified value)
 - 5) Select screen provided by the manufacturer, which has in a black background a box of CHYLW (brightest yellow). The size of box is at least 5 cm per side but not more than 25 % of the total screen area. Check that the level of CHYLW is within the tolerances of ΔC^* (not greater than 8 units of ΔC^*) and ΔL^* (be within 20 % of its specified value)
 - 6) Select screen provided by the manufacturer, which has in a black background a box of BKAJ2 (darkest grey). The size of box is at least 5 cm per side but not more than 25 % of the total screen area. Check that the level of BKAJ2 is within the tolerances of ΔC^* (not greater than 8 units of ΔC^*) and ΔL^* (be within 20 % of its specified value)
- b) The day-black-background, dusk, and night tables shall be tested as follows.
 - 1) The person conducting the test shall have passed the Ishihara colour blindness test taken by mariners and shall adapt to night viewing for 10 min before checking the night display.
 - 2) The brightness and contrast controls shall be set to their calibrated settings.
 - 3) While the display is off, adjust the light level reflected from white paper positioned on the display screen to the following values in table 1.

Table 1 – Light levels

Time period	Light level
Day-black-background	$200 \text{ cd/m}^2 \pm 50 \%$
Dusk	$10 \text{ cd/m}^2 \pm 50 \%$
Night	Darkness (ECDIS display predominant light)

Preferably use natural daylight for the two daytime tables.

- 4) Under each of the above conditions display the appropriate colour differentiation test diagrams described in S-52 appendix 2, annex A, part 3, section 4.1 for the above tables. Select each table in turn and ensure that:
 - each foreground stripe is clearly distinguished from its background;
 - the foreground stripes representing yellow, orange, magenta, green, blue and grey may be clearly identified.
- 5) Under each of the above conditions display the black adjust boxes available from ECDIS chart 1 (the chart AA5C1ABO of ECDIS chart 1). Select each table in turn and ensure that:
 - symbol BLKADJ01 is clearly distinguished from its background;

6.7.3.3 Other requirements

- a) Verify that the procedure for on-board use of the colour differentiation test diagrams is defined in the equipment manual.
- b) If an optical filter is provided for use with the equipment; check that it can be removed from the display. From manufacturer's data verify that it has eight times attenuation (i.e. 0,9 neutral density).
- c) Check that means are provided to return the display to the calibrated brightness and contrast settings.
- d) Verify that the equipment manual includes a warning that use of a brightness control may inhibit visibility of information, particularly when using the night colour tables.
- e) Verify by observation that each of the five mandatory colour tables provided in the presentation library may be selected.

6.7.4 Resolution (4.9.3 / 5.8.2)

From information supplied by the manufacturer verify that the resolution requirement defined in 5.8.2 is met.

6.7.5 Display characteristics (4.9.2 / 4.9.4 / 5.9)

Measure the displayed chart area while in route monitoring mode and check that it is at least 270 mm by 270 mm.

Ensure that the displayed information is clearly visible to more than one observer, in the conditions of light normally experienced on the bridge of the ship by day and by night.

Check that in route monitoring mode any windows superimposed on the chart display area are removable or can be moved.

Check that a mariner's information panel on the same screen as the route monitoring display uses only the "user interface" colours defined in the presentation library or clearly visible colours which do not detract from the chart display in any of the five mandatory colour tables and can be accepted as equivalent to the "user interface" colours.

6.8 Functional requirements

(4.3.8 / 4.3.8.1)

The following tests shall be performed both in route planning and route monitoring mode. The initial latitude/longitude position shall be that provided in the instruction manual for the IHO test data set. For all tests, confirm that there is no degradation in information content.

6.8.1 Standard display (4.2.4 / 4.3.4 / A.2)

Follow manufacturer's instructions to reinitialize EUT as if power had never been applied. Turn off EUT and turn EUT back on. Re-enter the initial latitude/longitude position. Confirm that the scale displayed conforms to the largest scale available in the SENC for the displayed area as shown on the graphical representation of the standard display provided with the IHO test data set. Confirm that the display mode is indicated.

6.8.2 Display base (4.2.5 / 4.3.1 / 4.3.2 / 4.3.3 / 4.3.5 / 5.7 / A.1)

Select standard display. Add selectable information. Remove all selectable information. Check that the EUT display is the same as the graphical representation of the display base for the IHO test data set for IEC 61174. Verify that the standard display can be restored by a single operator action. Confirm that the display mode is indicated.

6.8.3 All other information (4.3.1 / 4.3.2 / 4.3.7 / 4.6.1 / 5.2 / A.3)

Select standard display. Add all other SENC information and check that the EUT display is the same as the graphical representation of the complete IHO test data set for IEC 61174. Confirm that the display mode is indicated.

6.8.4 Display priorities (4.3.1 / 4.3.2 / 4.6.1 / 5.2)

Load ENC test data set A and check in detail that the drawing priority of the EUT display conforms with the drawing priority of the graphical presentation supplied with the IHO test data set.

6.8.5 Additional display functions (4.3.1 / 4.3.10 / 5.5.1 to 5.5.3 / 5.7)

Check that the additional display information can be displayed on demand.

- a) Verify that the navigator's notes can be displayed.
- b) Using three different symbols, check that these may be positioned at user-defined locations on the display. Similarly check that 10 lines, 25 text characters and two areas can be drawn at user defined locations. Check that all information added by the mariner is distinguishable as described in S-52 appendix 2/2.3.1b, except for colour fill. Check that one of the areas can be filled, as described in S-52 appendix 2/2.3.1b. Check that all of these objects (symbols) can be added to the SENC. Recall them from the SENC and check that they may be deleted.
- c) If the manufacturer displays information, check that the presentation of the information conforms with the following:
 - .1 the caution (!) or information (i) symbol is used to call up a note on the alphanumeric display by cursor picking;
 - .2 simple lines, or areas without colour fill, are set up for cursor picking to give an explanatory note in the alphanumeric display. Colour fill shall not be used;
 - .3 manufacturer information is distinguishable as described in S-52 appendix 2/2.3.1c), and does not overwrite i.e. degrade HO chart information.
- d) It shall not be possible to adjust depth information by changes in tidal height.
- e) If non-ENC data is mixed with ENC, then it shall be distinguishable as described in S-52 appendix 2/2.3.1c. If the non-ENC data is clearly separated from the ENC data, it may be symbolized in the same way as ENC data, provided that a prominent warning of "non-ENC data" is displayed, and the area of non-ENC data is marked as defined in S-52 appendix 2, 8.5.2 of annex A.

6.8.6 Scale and navigation purpose (4.5 / 4.5.1 / 4.5.2 / 5.3.1 / 5.5.2)

- a) Display information at a larger scale than that in the ENC (overscale) by zooming in, and ensure that an indication is provided.
- b) Select the less detailed navigation purpose cell which includes own ship's position, covered by the more detailed navigational purpose cell in the ENC and ensure that an indication is provided.
- c) Select an area where different compilation scales appear on the display. Verify a boundary line between different scales is indicated. Check if areas which are overscaled are identified as specified in S-52 appendix 2.
- d) Verify that if the display cannot be completely covered with data for the detailed navigational purpose, the remaining part of the display will be covered by the data for the more general navigational purpose.
- e) A graphical index of the scale boundaries shall be shown on demand.
- f) Verify the ability to use intermediate display scales.
- g) Verify the SCAMIN attribute removes clutter when changing to a smaller scale. Compare this with the graphical representation for SCAMIN attribute provided with the IHO test data set.

- h) Verify that a scale bar is provided as part of the display base at a scale of 1:80 000 or larger.
- i) Verify that a latitude bar is provided as part of the display base at a scale smaller than 1:80 000.
- j) Set a display scale larger than 1:80 000 (e.g. 1:25 000) or the equivalent radar range scale and check that the 1 mile scale bar is displayed between 2 mm and 4 mm from the left side of the chart display area. Set a display scale smaller than 1:80 000 or the equivalent radar range scale and check that the latitude scale is displayed between 2 mm and 4 mm from the left side of the chart display area.

6.8.7 Mode and orientation (4.7.1 to 4.7.4 / 5.4.2 / 5.9)

- a) Check that the north arrow symbol is always displayed at the top left corner of the chart area, not overlapping the scale or latitude bar. If the EUT offers the capability to show other than north-up presentation, check that the symbol realigns to north.
- b) Ensure that true motion is provided. Reset the display and check that the generation of the neighbouring area takes place automatically at a distance selected by the mariner.
- c) Check that it is possible to change manually the chart area and the position of own ship relative to the edge of the display.
- d) Where a ship centred display mode is provided, select a display scale such that the display shows only a portion of the chart which lies entirely within an area which is symbolized with a centred symbol (e.g. traffic lane). Check that over-writing between the ship symbol and the centred symbol does not occur or, the own ship symbol allows adequate visibility for the covered "centred" symbol.

6.8.8 Safety contour (4.3.6 / 5.4.3 / A.1.4)

- a) Switch on. Do not select a safety contour. Check that the equipment defaults to a 30 m safety contour depth.
- b) Select a depth contour value not contained in the SENC. Verify that the EUT selects the next deeper contour in the SENC and clearly indicates the selected contour.
- c) Compare safety contour display with appropriate graphical representation provided with the IHO test data set. Verify that safety contour is emphasized. Ensure that isolated dangers within the ship's safety contour are indicated.

6.8.9 Safety depth (4.3.7)

For the display of spot soundings, set initial safety depth to 10 m. Compare safety depth display with appropriate graphical representation provided with the IHO test data set. Verify that spot soundings less than the safety depth are emphasized. Repeat test for 7 m and for 12 m. These depths are chosen because they are not depth contours.

6.8.10 Object information (4.10.5.12 / 5.4.1)

- a) Enter the geographic coordinates of a position, and display that position. Select a point, which may be a feature, symbol or position, and display its geographic coordinates.
- b) Select by cursor an example of each of the following area, line and point objects. (See table 2.) Check that the information on the object contained in the ENC is displayed. Information on other objects may also be displayed.

Table 2 – Area, line and point objects

Area	Line	Point
Depth	Depth contour	Buoy
Restricted	Ferry route	Light
Sea	Recommended track	Wreck

- c) Check that text associated with chart objects is displayed only when selected and may be removed.

6.8.11 Navigation related functions (4.10.5 / 4.10.5.11 / 4.11.2 / annex B)

Verify that at least one EBL and VRM is available. Ensure that all the other symbols required for navigation purposes and specified in annex B are available.

6.8.12 Position integration (4.10.5.6 / 4.10.5.7 / 4.10.5.9 / 4.10.5.13 / 4.12.1)

- a) Remove the simulated position input and connect a continuous positioning system to the EUT and verify that the correct position is displayed.
- b) With a second, independent positioning method ensure that the EUT displays any difference in reported positions.
- c) Remove the positioning input to the EUT and ensure that an indication is given.
- d) Simulate a message from the positioning device which indicates an error condition, and observe that the alarm or indication is repeated by the EUT as an indication.
- e) Select a different geodetic datum between the positioning system and the SENC, and ensure that an alarm is given.
- f) Adjust the position manually. Observe that the amount of the correction is displayed on the screen and that the position changes accordingly. Recheck periodically to see it remains unchanged.
- g) Verify that the manufacturer's documentation includes guidance for implementing a common reference system (offsets).

6.8.13 Radar and plotting information (4.6.1 / 4.6.3.2 to 4.6.3.5 / 5.2)

Where the capability for displaying radar and plotting information is provided:

- a) observe the display without radar overlay, switch on the radar overlay and plotting information and ensure that the SENC information is not degraded, and is clearly distinguished;
- b) observe the display without radar, then switch on the radar overlay and plotting information and ensure that these match in scale, orientation, projection and accuracy, within the ranges defined in annex 4 to IMO Resolution MSC.64. Check that a change of scale of the radar, if it is a separate unit, does not affect the EUT/radar image in scale, orientation, projection and accuracy;
- c) ensure that the displayed position of the ship may be adjusted manually;
- d) note that the accumulated offset is clearly indicated;
- e) ensure that the radar and plotting information may each be removed by single operator action;
- f) set EUT to accept and display transferred plotting targets. Set the simulator to the equivalent of stabilized, north-up mode and to 12-mile range. Check that the target information is being accepted and displayed correctly;
- g) vary the radar antenna offset and confirm that the position of radar overlay and plotting information on the EUT changes accordingly.

For this test a radar target in a fixed position shall be simulated.

6.8.14 Loading of corrupted data (4.3.9 / 5.10.4)

- a) Load an example of corrupted ENC test data. Verify that EUT provides the appropriate warning.
- b) Load the IHO ENC test data set. Enter an example of a corrupted update. Verify that the reception procedure is terminated and the update record is flagged as invalid.
- c) Verify that the user is informed of the corruption.

6.8.15 Automatic updates (4.3.8 to 4.3.10 / 4.4.4 to 4.4.8)**6.8.15.1 Receipt – installation and application** (5.1 / 5.10.1.4 / 5.10.3 / 5.10.4 / 5.10.6 / 5.10.7)

- a) Verify that the system can receive updates via a 3,5 inch diskette or equivalent media.
- b) Apply the test update number 1 to the IHO ENC test data set.
- c) Identify the issuing authority of the update. Check that this conforms with the corresponding identifier of the ENC.
- d) Attempt to load an improperly sequenced update; check that the update is rejected and that a warning is given to the user.
- e) Attempt to load an update related to a newer edition of ENC; check that the update is rejected and the user is informed that a newer edition is available.
- f) Attempt to load an update related to an older edition of ENC; check that the update is rejected and the user is informed that the update belongs to a previous edition.

6.8.15.2 Display – show and verify (4.3.9 / 4.3.10 / 4.4.4 / 4.4.8 / 5.10.1.1 / 5.10.1.2 / 5.10.10 / 5.10.11)

- a) Ensure that the edition date/update number is displayed on request.
- b) Ensure that the contents of the updates have been included in the SENC, by displaying the SENC contents and highlighting updates.
- c) Ensure that updates not relating to an ENC cell within the SENC are discarded.
- d) Ensure that official ENC updates can be distinguished from local updates.
- e) Verify that, once accepted, integrated updates are indistinguishable from ENC data.

An update shall be applied to the SENC, displayed, and then manually annotated as rejected by the mariner, i.e. it shall not be possible for the mariner to reject an officially issued update by omitting its application entirely.

6.8.15.3 Records and logs (4.4.7 / 4.4.8 / 5.10.1.3 / 5.10.5 / 5.10.8)

Tests shall be applied in all EUT operating modes, i.e. route planning and route monitoring.

- a) List on the display, and observe the contents of the record of updates, including the time of application to the SENC.
- b) Verify that the log file contains the following information:
 - .1 date and time of application/rejection;
 - .2 complete and unique identification of update described in the S-57 product specification;
 - .3 any anomalies encountered during application;
 - .4 type of application: manual/automatic.
- c) Verify that the summary report for the update set provides the following information:
 - .1 identification of issuing authority;
 - .2 update numbers of the update files;
 - .3 cell identifiers of cells affected;
 - .4 edition number and date of ENC cells involved;
 - .5 number of updates in the affected cells.

6.8.16 Manual updates (4.4.6 / 5.10.1.2 / 5.10.2.1 to 5.10.2.3)

Using the test data subset C, as described in annex F, check that the following manual update procedures may be carried out and that the update is distinguishable as described in S-52 appendix 2/2.3.4.

- a) Add new point and restricted area features from the presentation library, locating them at selected positions.
- b) Delete an existing feature.
- c) Check to see that any update text information relevant to the new condition and to the source of the update and entered by the mariner is recorded by the system. Verify that this update can be re-displayed on demand.
- d) Verify that EUT is capable of sensing indications and alarms related to the SENC data, whether from automatic or manual updates.
- e) Verify that manual updates are distinguishable as described in S-52 – appendix 2 / 2.3.4.
- f) Verify that any manual updates removed from the display during the last 3 month period are retained and can be reviewed.

6.8.17 Self-tests of major functions (4.13 / 4.13.1 / 4.13.2)

- a) Perform tests of the major functions which are supported by the EUT. Verify that the EUT provides appropriate display information and indications.
- b) Simulate the following sensor malfunctions (including for radar if provided for):
 - .1 interruption of sensor input (loss of signal);
 - .2 invalid sensor information (status);
 - .3 physical breakdown of sensor connection.
- c) Verify that the system provides suitable alarms or indication of system malfunction arising from failures.

6.9 Operational requirements

6.9.1 Ergonomic principles

- a) The EUT shall comply with the ergonomic principles noted in 5.9 and IEC 60945.
- b) The acoustic alarm level must be capable of the maximum defined in IEC 60945 but may be adjustable below this limit.

6.9.2 Route planning (4.9.1 / 4.9.1.1 / 4.9.2 / 4.10.1 / 4.10.4.1 to 4.10.4.6 / 5.4.3 / 5.8.1)

- a) For the routes to be planned as described below, the following general guidelines apply:
 - .1 initially plan the route without specifying a safety contour. Ensure that the default value is 30 m or the next deeper contour;
 - .2 at least one leg shall enter an area where the specified safety contour is not available. Ensure that the safety contour defaults to the next deeper contour and an indication is provided to the mariner;
 - .3 at least one leg shall cross a safety contour. Ensure that an indication is provided;
 - .4 at least one leg shall cross the boundary of a prohibited area. Ensure that an indication is provided;
 - .5 at least one leg shall cross the boundary of a geographical area for which special conditions exist. Ensure that an indication is provided;
 - .6 at least one leg of the route shall be planned through an area of the ENC test data at a different scale. Set to test the 5 s maximum redraw;
 - .7 each leg shall be planned with an appropriate off track limit (e.g. 100 m);
 - .8 course changes shall be made, both to starboard and port, between different legs of the route and shall vary from 5° up to 175°;
 - .9 the length of the legs shall vary from 0,5 nautical mile to at least 3 nautical miles with a total length of at least 25 nautical miles;
 - .10 planned speed shall vary between 5 knots and 15 knots;
 - .11 the planned route shall cross at least 3 cells of the ENC.
- b) Observe that the displayed information for route planning, route monitoring and supplementary navigation tasks, such as pilotage or chart work is available.

- c) Plan a route which uses at least 10 waypoints:
 - .1 test that the route can be planned using both straight and curved segments;
 - .2 save the planned route.
- d) Retrieve the planned route and plan an alternate route as follows:
 - .1 add three waypoints;
 - .2 delete three waypoints;
 - .3 change position of two waypoints;
 - .4 change order of waypoints in the route;
 - .5 save the alternate route.
- e) Plan complex tracks using scenarios No. 2 and No. 3 as noted in annex J and save the tracks. Check that track distances comply with those noted in annex J and that no distortions are visible.

6.9.3 Route monitoring (4.9.1 / 4.9.1.2 / 4.9.2 / 4.10.3 / 4.10.4.5 / 4.10.5.2 to 4.10.5.5 / 4.10.5.8 / 4.10.5.10 / 4.10.5.11 / 4.11.1 / 5.4.3 / 5.8.1)

- a) For route monitoring, the following general guidelines apply:
 - .1 initialize simulator at the starting position for the planned route;
 - .2 select standard display and select the route;
 - .3 the route shall be planned through an area covered by the IHO ENC test data set;
 - .4 carry out route monitoring using the selected routes and starting at waypoint 1;
 - .5 at least one leg shall cross own ship's safety contour;
 - .6 at least one leg shall enter an area where the specified safety contour is not available;
 - .7 at least one leg shall cross an overscale area. Verify that this is indicated.
- b) Operate the own ship position function, and observe that the display shows own ship's position.
- c) Shortly before the vessel enters an area for which an alarm will be released (safety contour and prohibited areas) perform the following actions:
 - .1 display a sea area ahead of ship's position and outside present display (look ahead);
 - .2 verify that the appropriate alarms/indications are provided;
 - .3 return to own ship's position by a single operator action and verify that this takes no more than 5 s.
- d) When the vessel enters the area where the specified safety contour is not available, ensure that the safety contour shown defaults to the next deeper contour.
- e) Verify that an alarm is released each time the vessel is going to cross the boundary of a prohibited area or safety contour, within the time specified by the mariner.
- f) Select a scale smaller than the largest one available for the area. Simulate crossing over the safety contour. Check that an alarm is generated by EUT using data from the largest available scale.
- g) Using the ENC test data set:
 - .1 simulate own ship's movement from an area of large-scale data into an adjoining area of small scale data. Ensure that each re-draw which occurs until the display is wholly within the small scale area is completed in less than 5 s. (The situation where official chart data is not available is outside the scope of this test.);
 - .2 select the display of an area not currently displayed, at least 10 nautical miles from own ship position and which is covered by ENC data at a scale different from the one in use. Check that the old display is maintained from the start of the regeneration until the start of re-draw of the new display. An indication shall be given if the regeneration time is more than 5 s;
 - .3 simulate deviation from intended track and verify that the off-track alarm is released;

- .4 verify that an alarm is released each time, within the time or distance specified, when a critical point has been reached by or is abeam of the ship;
 - .5 display the alternative route and ensure that it is clearly distinguishable from the selected route. Change to the alternative route and verify that this becomes the selected route;
 - .6 modify the selected route by adding a new waypoint;
 - .7 select an automatic time interval, in a range 1 min to 120 min: simulate the vessel's movement, and verify that the time labels are displayed. Ensure that time labels may also be entered manually.
- h) Reload complex route of scenario No. 2 and start monitoring the route with the first waypoint. Confirm that all waypoint changes, bearings and distances are calculated and displayed correctly during route monitoring.
- i) Reload complex route of scenario No. 3 and start monitoring the route with the first waypoint. Confirm that all waypoint changes, bearings and distances are calculated and displayed correctly during route monitoring.

6.9.4 Twelve-hour log (4.10.5.13 / 4.10.5.14 / 4.10.6.1 / 4.10.6.3 / 4.10.6.4)

For recording purposes (see below) the data resolution shall be in accordance with 6.7.2.

- a) For voyage recording a separate test route plan shall be made. The route plan shall be designed as a loop. It shall be possible for the simulator to carry out this test automatically.
- b) Continue to run the test for 12 h. During this period, attempts should be made to manually edit the log. This shall not be possible. At the end of the twelve-hour period, the EUT log shall then be analyzed according to the procedures in the operating manual and the results shall comply with the test carried out.
- c) Ensure that the record for the previous 12 h including all the items defined in 4.10.5.13 and 4.10.6.1, is stored and available on demand. Check that chart data according to 4.10.6.1 and 4.10.6.2 is stored.

6.9.5 Voyage record (4.10.6.2 to 4.10.6.4)

- a) Verify that the EUT records the track for the entire voyage, with time marks at intervals not exceeding 4 h. Verify that the logging capacity for the voyage has a minimum capacity of three months.
- b) Ensure that the record, for the previous 12 h. and the voyage track, once recorded, can be preserved.

6.9.6 Power supply (4.15.2)

Interrupt the power supply for 45 s, and ensure that the equipment does not need to be re-initialized manually.

Operator settings shall be checked that they have not changed.

Annex A (normative)

SENC information to be displayed during route planning and route monitoring - (Appendix 2 of IMO resolution A.817)

- 1 *Display Base, permanently retained on the ECDIS display, consisting of:*
 - .1 *coastline (high water);*
 - .2 *own ship's safety contour (to be selected by the mariner);*
 - .3 *indication of isolated underwater dangers of depths less than the safety contour which lie within the safe waters defined by the safety contour;*
 - .4 *indication of isolated dangers which lie within the safe water defined by the safety contour such as bridges, overhead wires, etc., and including buoys and beacons whether or not these are being used as aids to navigation;*
 - .5 *traffic routeing systems;*
 - .6 *scale, range, orientation and display mode;*
 - .7 *units of depth and height.*
- 2 *Standard Display, to be displayed when the chart is first displayed by ECDIS, consisting of:*
 - .1 *display base;*
 - .2 *drying line;*
 - .3 *indication of fixed and floating aids to navigation;*
 - .4 *boundaries of fairways, channels, etc.;*
 - .5 *visual and radar conspicuous features;*
 - .6 *prohibited and restricted areas;*
 - .7 *chart scale boundaries;*
 - .8 *indication of cautionary notes.*
- 3 *All Other Information. All other information displayed individually on demand, for example:*
 - .1 *spot soundings;*
 - .2 *submarine cables and pipelines;*
 - .3 *ferry routes;*
 - .4 *details of all isolated dangers;*
 - .5 *details of aids to navigation;*
 - .6 *contents of cautionary notes;*
 - .7 *ENC edition date;*
 - .8 *geodetic datum;*
 - .9 *magnetic variation;*
 - .10 *graticule;*
 - .11 *place names.*

Annex B (normative)

Navigational elements and parameters (Appendix 3 of IMO resolution A.817)

1. *Own ship*
 - 1.1 *Past track with time marks for primary track*
 - 1.2 *Past track with time marks for secondary track*
2. *Vector for course and speed made good*
3. *Variable range marker and/or electronic bearing line*
4. *Cursor*
5. *Event*
 - 5.1 *Dead reckoning position and time (DR)*
 - 5.2 *Estimated position and time (EP)*
6. *Fix and time*
7. *Position line and time*
8. *Transferred position line and time*
 - 8.1 *Predicted tidal stream or current vector with effective time and strength (in box)*
 - 8.2 *Actual tidal stream or current vector with effective time and strength (in box)*
9. *Danger highlight*
10. *Clearing line*
11. *Planned course and speed to make good. Speed is shown in box.*
12. *Waypoint*
13. *Distance to run*
14. *Planned position with date and time*
15. *Visual limits of lights arc to show rising/dipping range*
16. *Position and time of 'wheelover'*

A full definition of the navigation symbols is in annex E.

Elements 1.1 and 1.2 refer to the tracks from primary and secondary positioning methods.

Annex C (normative)

Areas for which special conditions exist (Appendix 4 of IMO resolution A.817)

The following are the areas which ECDIS shall detect and provide an alarm or indication under 4.10.4.5 and 4.10.5.4.

Traffic separation zone

Traffic routeing scheme crossing or roundabout

Traffic routeing scheme precautionary area

Two way traffic route

Deepwater route

Recommended traffic lane

Inshore traffic zone

Fairway

Restricted area

Caution area

Offshore production area

Areas to be avoided

Military practise area

Seaplane landing area

Submarine transit lane

Ice area

Channel

Fishing ground

Fishing prohibited

Pipeline area

Cable area

Anchorage area

Anchorage prohibited

Dumping ground

Spoil ground

Dredged area

Cargo transhipment area

Incineration area

Specially protected areas

Annex D (normative)

Alarms and indicators (Appendix 5 of IMO resolution A.817)

Sub Clause	Requirement	Information
4.10.3	<i>Alarm or indication</i>	<i>Largest scale for alarm</i>
4.10.4.6	<i>Alarm</i>	<i>Exceeding off track limits</i>
4.10.5.3	<i>Alarm</i>	<i>Crossing safety contour</i>
4.10.5.3	<i>Alarm or indication</i>	<i>Area with special conditions</i>
4.10.5.5	<i>Alarm</i>	<i>Deviation from route</i>
4.10.5.7	<i>Alarm</i>	<i>Positioning system failure</i>
4.10.5.8	<i>Alarm</i>	<i>Approach to critical point</i>
4.10.5.9	<i>Alarm</i>	<i>Different geodetic datum</i>
4.13.2	<i>Alarm or indication</i>	<i>Malfunction of ECDIS</i>
4.5.1	<i>Indication</i>	<i>Information overscale</i>
4.5.2	<i>Indication</i>	<i>Larger scale ENC available</i>
4.6.2	<i>Indication</i>	<i>Different reference system for added navigation information</i>
4.10.4.4	<i>Indication</i>	<i>Route planning across safety contour</i>
4.10.4.5	<i>Indication</i>	<i>Route planning across specified area</i>
4.13.1	<i>Indication</i>	<i>System test failure</i>

In this standard the definitions of indicators and alarms provided in IMO resolutions A.686 and A.830 apply.

Alarm: *An alarm or alarm system which announces by audible means, or audible and visual means, a condition requiring attention.*

Indicator: *Visual indication giving information about the condition of a system or equipment.*

Annex E (normative)

Navigational symbols

E.1 Introduction

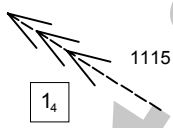
This annex provides a description of the navigational symbols to be used on ECDIS, as listed in annex B.

This annex has been developed to harmonize the navigational used on ECDIS with those used for electronic plotting (IEC 60872 series), and future symbology to be developed for AIS.

E.2 Symbols

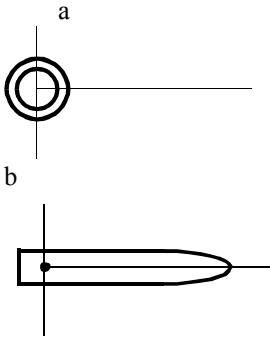
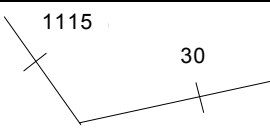
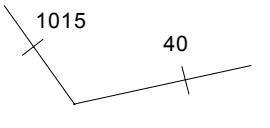
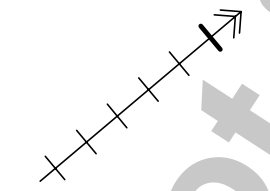
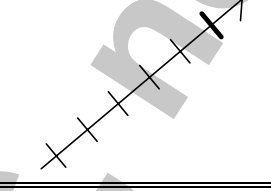
- If navigation symbols are used on another navigation equipment e.g. ARPA's, these symbols, the colour palette and symbol sizes used in such cases are to be left to the discretion of the manufacturer.
- Additional symbols may be used for other navigational purposes provided that they do not conflict with the ECDIS navigational and chart symbols or the ARPA symbols and that they use appropriate colour palettes.
- Alphanumeric labels are to be of a size such that they are clearly legible.
- Colours for the symbols are defined in the IHO ECDIS presentation library.




E.2.1 Symbol definition format

Tidal stream				
8.1		Predicted tidal stream or current vector with effective time and strength (in [3] box)	Predicted from tidal database	ninfo
[2]	[3]	[4]	[5]	[6]


- [1] Section
 [2] Subsection number
 [3] Symbol to be used on ECDIS
 [4] Description in the English language
 [5] Notes
 [6] Colour token (IHO ECDIS presentation library)

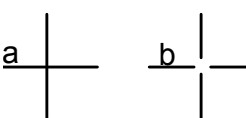
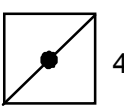
E.2.2 Route monitoring and route planning symbols

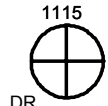

Route monitoring - position lines				
1		Own ship	<p>The use of symbol 1– a/b on radar systems is optional.</p> <p>Symbol 'b' must be scaled to indicate length and beam of the vessel and may be representative of own ship's outline.</p> <p>In either case the largest dimension of the symbol shall not be less than 6 mm.</p> <p>Heading and beam lines are optional. If displayed, heading line extends to chart window edge and beam line extends 10 mm (optionally extendable).</p>	ships
1.1		Past track with time marks for primary track	<p>Time mark intervals may be set by the operator.</p> <p>Time to be HHMM or MM.</p>	pstrk
1.2		Past track with time marks for secondary track	<p>Time mark intervals may be set by the operator.</p> <p>Time to be HHMM or MM.</p>	sytrk
2.1		Own ship's vector for course and speed made good (i.e. over ground)	<p>Marks at 1 min intervals.</p> <p>Filled mark at 6 min intervals. Length represents user selected period applied to ALL vectors.</p>	ships
2.2		Own ship's vector for course and speed through water	<p>Marks at 1 min intervals.</p> <p>Filled mark at 6 min intervals. Length represents user selected period applied to ALL vectors.</p>	ships


Target tracking – AIS reported targets				
2.3		"Active" AIS target	Centre is pivot point. Orientated with heading. Heading line is 25 mm long.	arpat
2.4		"Sleeping" AIS target To avoid confusion with AIS target with no associated vector.	Centre is pivot point. Orientated with heading. "Sleeping" AIS has no vector.	arpat
2.5		Vector for course and speed made good (i.e. over ground).	Marks at 1 min intervals. Filled mark at 6 min intervals. Length represents user selected period applied to ALL vectors.	arpat

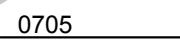
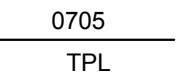
Electronic plotting video symbols - IEC 60872				
2.6	See IEC 60872	Plotted target – Course and speed vector IEC 60872 video symbol 4A		arpat
2.7	See IEC 60872	Vector for course and speed made good (i.e. over ground). IEC 60872 video symbol 4B	Marks at 1 min intervals. Thick mark at 6 min intervals. Length represents user selected period applied to ALL vectors.	ships
2.8	See IEC 60872	Vector for course and speed through water. IEC 60872 video symbol 4B	Marks at 1 min intervals. Thick mark at 6 min intervals. Length represents user selected period applied to ALL vectors.	ships

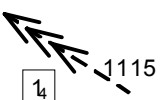
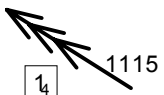
Route monitoring - position lines				
3		Variable range marker and/or electronic bearing line	<p>The VRM and EBL may be ship centred or freely movable.</p> <p>A small filled circle indicates the EBL origin when offset.</p> <p>An EBL is to be an interrupted line with long dashes.</p> <p>The first VRM is to be a long dashed ring.</p> <p>The second VRM is to be a long dashed ring distinguished by a different line style of dashes.</p>	ninfo

Route monitoring – general				
4		Cursor	The cursor crossover point may be left blank as shown in 'b'. In either case the largest dimension of the symbol shall not be less than 10 mm.	cursr
5		Event	The symbol may be numbered and have additional text such as time / "MOB" associated with it.	ninfo
All own ship references relate to the conning position				

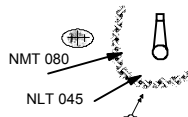
Route monitoring - calculated positions (indicated by thickened circle)				
5.1		Dead reckoning position and time (DR)		ninfo
5.2		Estimated position and time (EP)		ninfo

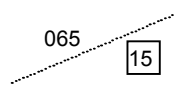
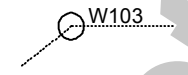
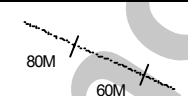
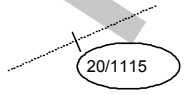
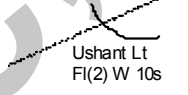
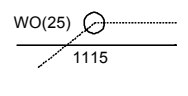
Route monitoring - position fixes				
6	<div>1115</div> <div></div> <div>X</div>	Fix and time	X indicates method of fix	ninfo
V	Visual	Gl	Glonass	
A	Astronomical	L	Loran/Tchaika	
R	Radar	M	MFDF	
D	Decca	O	Omega	
G	GPS	T	Transit/Tsikada	
A differential system is denoted by a prefix 'd', e.g. dG, dO etc.				

Route monitoring – position lines				
7		Position line and time		ninfo
8		Transferred position line and time		ninfo

Route planning – tidal stream				
8.1		Predicted tidal stream or current vector with effective time and strength (in box)	Predicted from tidal database	ninfo
8.2		Actual tidal stream or current vector with effective time and strength (in box)	Measured from available sensor information. Strength to be displayed in knots	ninfo

Route planning – danger highlight				
9		Danger highlight	Transparent red danger arcs drawn by the operator. May be flashing. Examples shown are wrecks. All underlying chart data shall be clearly visible.	dnghl

Route planning – clearing lines				
10		Clearing line NMT = Not more than NLT = Not less than	Example is shown for clearing a wreck and north mark buoy	ninfo

Route monitoring – Calculated positions (indicated by thickened circle)				
11		Planned course and speed to make good. Speed is shown in box.		plrte/aplrt
12		Waypoint (Used in conjunction with symbols 14 and 19)	Waypoints may be labelled. Label shall be unique. First character shall be a letter but not 'O', 'I' or 'Z'	plrte/aplrt
13		Distance to run	May be replaced by more direct means	plrte/aplrt
14		Planned position with date and time.	May be replaced by more direct means	plrte/aplrt
15		Visual limits of lights, arc to shore rising/dipping range	Inscriptions are optional NOTE – not shown on alternate route	ninfo
16		Estimated position and time (EP). Position and time of "wheel-over" *	Minimum symbol to indicate "wheel-over" line (annotated 'WO'), other data can be optionally provided. NOTE – not shown on alternate route	ninfo

- "wheel-over" is defined as a geographic position along the ship's intended track where, taking into account the dynamics of the ship and the prevailing environmental conditions, the mariner considers it necessary to put the "wheel-over" to achieve the intended new track.

Annex F (normative)

ENC test data set

F.1 General requirements

This data set is necessary to accomplish all ECDIS testing requirements which are specified in this standard. The data shall be encoded according to the IHO ENC product specification included in S-57. The data shall be provided, in an unencrypted form on CD-ROM.

The test data set shall include:

- data subset A for testing the ENC;
- data subset B for testing automatic updating;
- data subset C for testing manual updating.

In addition to these data sets the following shall be provided:

- an instruction manual;
- a set of graphical representations;
- a read-me file which shall include this specification together with an index to the data contents.

References to other IHO publications are to the latest editions of S-52 and its appendices 1 and 2.

F.2 Data subset A – ENC

F.2.1 Complex area

This data set shall cover a complex area representing a complicated navigational scenario.

The contents shall include:

- a) at least four, large-scale cells (>1:80 000) providing continuous coverage;
- b) an area containing no data;
- c) examples of features named in both English and another language;
- d) examples of features from each of the priority layers defined in 5.3(a) of S-52 and 2.3.2 of appendix 2 of S-52;
- e) examples of features making use of SCAMIN;
- f) examples of features making use of INFORM;
- g) an example of an object, attribute and attribute value not valid for ENC purposes;
- h) at least two scale-area meta objects;
- i) an example of corrupted data;
- j) an example of a feature which is depicted as an area with an associated area-centred symbol;
- k) an example of objects (see 6.8.10 table 2);
- l) an example of “unofficial” data, (i.e. data whose source identification indicates that the data is non-HO). This data should be in a datum other than WGS-84. Part of the “unofficial” data shall be superimposed on HO produced ENC data.

F.2.2 Small scale data

The data set shall include equivalent data for the next smaller scale navigational purpose for the area specified in F.2.1. The data shall be at a scale of <1:80 000 and shall include an area sufficient to cover a route of 25 nautical miles. It shall also include an area situated at least 10 nautical miles from the centre of the specified area.

F.2.3 Data content

The content of the data set shall support the use of display base, standard display and all other information as specified in annex B.

F.2.4 Alarms and indications

The data set shall include:

- a) the 0 m, 10 m, 20 m, 30 m and 40 m depth contours in one cell and the 0 m, 10 m, 25 m, 30 m and 40 m depth contours in an adjacent cell;
- b) a range of spot soundings, including a 5 m and 15 m sounding;
- c) examples of all features which trigger alarms or indications as listed in annex D.

F.2.5 Alarms and indications: large-scale data

Where the large-scale data (F.2.1) and the smaller scale data (F.2.2) overlap, the large-scale data set shall be more geometrically complex than the smaller scale data for features which trigger alarms and indications.

F.2.6 Mathematical calculations

A separate text document shall be provided containing a selection of positions, distances, bearings, etc. relating to the data set and which support examples of all the navigational calculations listed in 7.1 of S-52.

F.2.7 Graphical representations

Graphical representations of the data set shall be provided to the requisite accuracy and resolution for:

- a) base display;
- b) standard display;
- c) all other information;
- d) small-scale representation of data for area F.2.1 to demonstrate the use of the SCAMIN attribute; and
- e) small-scale data for area F.2.2.

F.3 Data subset B – Automatic updating

F.3.1 Update data: contents

The data set shall include:

- a) multiple individual updates, certain of which shall affect topology;
- b) an update with an invalid producing agency identifier;
- c) an update referring to a superseded edition of a cell;
- d) an update which comes into effect at a future date.
- e) data which falls outside the area of data subset A;
- f) an example of corrupted data;

- g) a separate text document containing the required contents of the summary report and an application report described in 3.4.2(f) of appendix 1 of S-52.

F.3.2 Update data: sequence

The data set shall include a sequence of update, e.g. 1, 2, 3, 4 and 5, where 3 and 4 are logically linked but two versions of 3 are provided, one which makes 4 invalid, the other being compatible with 4.

F.4 Data subset C: manual updating

F.4.1 Update data: contents

A text document shall contain information for manual updating.

F.4.2 Update data: alarms and warnings

The text shall include reference to part of the contents of data subset C, including items which trigger alarms and warnings.

NOTE – The test data set, produced by the Canadian Hydrographic Service and the United Kingdom Hydrographic Office, is available from the International Hydrographic Bureau, Monaco – via: <http://www.iho.shom.fr>

Annex G (Normative)

Back-up arrangements (Appendix 6 of IMO resolution A.817)

NOTE - In sub clauses G.1 through G.6 of annex G, the text in italics is from the corresponding paragraph of appendix 6 of IMO resolution A.817. For example, sub clause G.2 is paragraph 2 of appendix 6 of A.817.

G.1 Introduction

As prescribed in 4.14, adequate independent back-up arrangements shall be provided to ensure safe navigation in case of ECDIS failure. Such arrangements include:

- .1 facilities enabling a safe take-over of the ECDIS functions in order to ensure that an ECDIS failure does not result in a critical situation;*
- .2 a means to provide for safe navigation for the remaining part of the voyage in case of ECDIS failure.*

It is a prerequisite that a means to provide for safe navigation for the remaining part of the voyage is established prior to departure and is available during the voyage.

It is a prerequisite that the route plan has been transferred to the back-up device prior to the departure and after reassignment of the route plan in order to enable a safe take over when ECDIS fails.

NOTE - This annex does not address the use of official paper charts as a back-up to ECDIS.

G.2 Purpose

The purpose of an ECDIS back-up system is to ensure that safe navigation is not compromised in the event of ECDIS failure. This shall include a timely transfer to the back-up system during critical navigation situations. The back-up system shall allow the vessel to be navigated safely until the termination of the voyage.

G.3 Functional requirements

G.3.1 Required functions and their availability

G.3.1.1 Presentation of chart information (See G.7.8.1)

The back-up system shall display in graphical (chart) form the relevant information of the hydrographic and geographic environment which is necessary for safe navigation.

G.3.1.2 Route planning (See G.7.9.2.)

The back-up system shall be capable of performing the route planning functions, including:

- .1 taking over of the route plan originally performed on the ECDIS;*
- .2 adjusting a planned route manually or by transfer from a route planning device.*

If more than one route can be displayed, the selected route shall be clearly distinguishable from the other routes.

G.3.1.3 Route monitoring

The back-up system shall enable a take-over of the route monitoring originally performed by the ECDIS, and provide at least the following functions:

- .1 plotting own ship's position automatically, or manually on a chart; (See G.7.8.5.)*
- .2 taking courses, distances and bearings from the chart;*
- .3 displaying the planned route; (See G.7.9.3)*
- .4 displaying time labels along ship's track; (See G.7.9.3)*
- .5 plotting an adequate number of points, bearing lines, range markers, etc., on the chart. (See G.7.8.4)*

G.3.1.4 Display information (See G.7.8.1.)

The back-up system shall be capable of displaying at least the information equivalent to the standard display as defined in the ECDIS performance standard. (See annex A.)

The back-up system shall at least display the pre-planned route, own ship's position, coast lines, navigable waters, dangers to navigation and aids to navigation. This display shall include identification of dangers and aids to navigation.

Any additional chart information as defined in annex A may be displayed and be subject to the same tests as the information in the standard display.

G.3.1.5 Provision of chart information (See G.7.5.1)

- .1 The chart information to be used shall be the latest editions of that originated by a government hydrographic office, and based on IHO standards.*
- .2 It shall not be possible to alter the contents of the electronic chart information.*
- .3 The chart or chart data edition and issuing date shall be indicated.*

G.3.1.6 Updating (See G.7.8.7.)

The information displayed by the ECDIS back-up arrangements shall be up-to-date for the entire voyage.

G.3.1.7 Scale (See G.7.8.2)

The back-up system shall provide an indication:

- .1 if the information is displayed at a larger scale than that contained in the database; and*
- .2 if own ship's position is covered by a chart at a larger scale than that provided by the system.*

G.3.1.8 Addition of radar and other navigational information

If radar and other navigational information are added to a back-up display, all corresponding requirements of the ECDIS performance standard shall be met. (See 4.6.) (See G.7.8.6.)

Radar information or other navigational information may be added to the back-up system display. However, it shall not degrade the chart information, and shall be clearly distinguishable from the chart information.

The back-up system and added navigational information shall use a common reference system. Such advice shall be included in the manufacturer's installation handbook.

Transferred radar information may contain both radar image and ARPA or ATA or EPA information.

Where plotting information is added it shall be indicated to the operator whether the vectors are relative or true.

If the radar image is added to the back-up system display, the chart and the radar image shall match in scale, orientation and projection.

The radar image and the position from the position sensor shall both be adjusted automatically for antenna offset from the conning position.

It shall be possible to offset the displayed position of the ship manually so that the chart image matches the radar display. If an offset is applied, it shall be clearly indicated.

It shall be possible to remove the radar or plotting information by a single operator action.

G.3.1.9 The display mode and generation of the neighbouring area

The display mode and generation of the neighbouring area shall be in accordance with section 7 of the ECDIS performance standard. (See 4.7.) (See G.7.8.3.)

It shall always be possible to display the chart in a north-up orientation. Other orientations are permitted.

The device shall provide for true motion mode. Other modes are permitted.

When true motion mode is in use, reset and generation of neighbouring area shall take place automatically at a distance from the border of the display, or from the centre of the screen, as determined by the mariner.

It shall be possible manually to change the chart area and the position of own ship relative to the edge of the display.

G.3.1.10 Voyage recording (See G.7.9.4 and G.7.9.5.)

The back-up arrangements shall be able to keep a record of the ship's actual track, including positions and corresponding times.

G.3.2 Reliability and accuracy

G.3.2.1 Reliability (See G.7.3)

The back-up arrangements shall provide reliable operation under prevailing environmental and normal operating conditions.

G.3.2.2 Accuracy

Accuracy shall be in accordance with section 11 of the ECDIS performance standard. (See 4.11.) (See G.7.6)

The accuracy of all calculations performed by the back-up system shall be independent of the characteristics of the output device and should be consistent with the chart accuracy.

Bearings and distances drawn on the display, or those measured between features already drawn on the display, shall have an accuracy no less than that afforded by the resolution of the display.

G.3.3 Malfunctions, warnings, alarms and indications (See G.7.8.8.)

The back-up system shall provide a suitable indication of system malfunction.

G.4 Operational requirements

G.4.1 Ergonomics (See G.7.7.2 and G.7.9.1.)

The back-up system shall *be designed in accordance with the ergonomic principles of ECDIS*. (See 5.9)

Any windows containing text, diagrams, etc. superimposed on the route monitoring display shall be temporary. Temporary for this application means that the window can be moved or removed from the display.

It shall be possible to re-locate such windows in a less important part of the display, such as on land, or behind the own ship symbol.

A mariner's information panel on the same screen as the route monitoring display shall use only the "user interface" colours from the presentation library colour tables. (See S-52 appendix 2/3.4.3.) Clearly visible colours which do not detract from the chart display in any of the five mandatory colour tables may be accepted as equivalent to the "user interface" colours required.

G.4.2 Presentation of information

G.4.2.1 Colours and symbols

Colours and symbols used in the back-up arrangements shall be based on IHO recommendations. (See 4.8.) (See G.7.7.1)

IHO recommended colours and symbols shall be the basis for presentation of chart information. The colours and symbols other than those mentioned in the relevant standards shall be those used to describe the navigational elements and parameters listed in annex B and described in annex E.

Chart information when displayed at the specified scale shall use the size specified in the relevant standards of symbols, figures and letters.

G.4.2.2 Effective size

The effective size of the chart presentation shall be in accordance with 4.9.2. (See G.7.7.2)

The effective size of the chart presentation for route monitoring shall be at least 270 x 270 mm.

G.5 Power supply (See G.7.9.6.)

- .1 the back-up power supply shall be separate from the ECDIS; and*
- .2 conform to the requirements in the ECDIS performance standard.* (See 4.15)

It shall be possible to operate the back-up system and all equipment necessary for its normal functioning when supplied by an emergency source of electrical power in accordance with the appropriate requirements of regulation II/1 of the 1974 SOLAS convention.

Changing from one source of power supply to another, or any interruption of the supply for a period of up to 45 seconds, shall not require the equipment to be re-initialised manually. The equipment is not required to remain operational during this interruption of the power supply.

G.6 Connections with other equipment (See G.7.2.)

G.6.1 Back-up

The back-up system shall:

- .1 *be connected to systems providing continuous position-fixing capability; and* (See G.7.8.5.)
- .2 *not degrade the performance of any equipment providing sensor input.*

G.6.2 Radar

If radar with selected parts of the ENC chart information overlay is used as an element of the back-up, the radar shall comply with annex 4 to IMO resolution MSC.64.

The minimum requirement for a back-up system is a single interface to an EPFS. Other interfaces are allowed.

G.7 Methods of testing and required test results

G.7.1 EUT installation and technical documentation

The equipment under test (EUT) shall be installed in compliance with the manufacturer's installation manual.

Where equipment is divided (e.g. route planning on one display and route monitoring on the other), the entire configuration shall be tested together.

The manufacturer shall provide sufficient information and documentation for the equipment to be understood and operated.

G.7.2 Interfaces (G.6)

During testing, specified digital signals shall be sent to the EUT equipment to emulate the position, heading and speed over ground of the own ship as appropriate. Signals may also be provided as necessary to represent radar returns appropriate to the equipment and the position of the ship. Tests shall be performed using a simulator (IEC 61162) or at sea.

- a) Signals carrying positional data shall conform to IEC 61162 series and the appropriate EPFS standard.
- b) Signals carrying heading information shall conform to IMO resolutions A.424 and A.821; any digital output shall conform to IEC 61162 series.
- c) Signals carrying speed information shall conform to IMO resolution A.824; any digital output shall conform to IEC 61162 series.
- d) Simulated ARPA signals may be provided by the supplier, and shall conform to IMO resolution A.823; any digital output shall conform to IEC 61162 series.
- e) Simulated real radar signals in accordance with annex 4 to IMO resolution MSC.64 may be provided.

An IEC 61162 series interface simulator shall be connected. Messages shall be sent and received.

G.7.3 Environmental (G.3.2.1)

All the general requirements of IEC 60945 appropriate to its category, i.e. "protected", shall be carried out. The manufacturer shall declare any preconditioning required before environmental checks. For the purposes of this standard the following definitions for "performance check" and "performance test", required by IEC 60945, shall apply:

Performance check	Reconfigure the EUT and check by non-quantitative visual checks that the system is still operative;
Performance test	For the purposes of IEC 60945 the "performance test" for ECDIS EUT shall be identical to the "performance check".

G.7.4 Preparation

G.7.4.1 Power-up

The installed EUT shall be powered up in accordance with the manufacturer's recommended procedures. Any self-testing shall be completed using simulated inputs. Signal generators shall be activated in a coherent manner to represent a stationary ship at the position selected. All the necessary selections to configure the equipment for the test environment shall be undertaken in accordance with the manufacturer's recommendations and settings.

G.7.4.2 Initial ship parameters

The following parameters shall be entered into the EUT for a simulated test:

Ship length	300 m
Ship beam	30 m
Ship draught	7 m
Conning position	
Aft of ship centre	100 m
On centre line	
Navigation receiver antenna	
Forward of conning position	5 m
Starboard of centre line	10 m
Radar antenna:	
Forward of conning position	7 m
On centre line	

The navigation receiver antenna offset shall be varied and it shall be confirmed that the position on the EUT changes accordingly.

G.7.5 Initial data tests

G.7.5.1 Chart (G.3.1.5)

- Check that the edition number and date of the chart included in the test data set is displayed in the chart library.
- Check by operation that it is not possible to alter the content of the chart.
- Ensure that the edition date/update number is displayed on request.

G.7.6 Accuracy (G.3.2.2)

The test shall verify:

- the accuracy of ECDIS calculations consistent with chart;
 - the measurement accuracy consistent with display resolution.
- Perform the measurements provided for in the IHO test data set and confirm that they meet the required accuracy. Check that the system can perform the following calculations:
 - transformation between a local datum and WGS-84;
 - true distance and azimuth between two geographical positions;
 - geographic position from known position and distance/azimuth;
 - rhumb line and great circle.
 - Calculate and display both a rhumb line and a great circle line according to test scenario 1 of annex J and verify that no visible distortion exists between these lines and the chart data.

This test shall be carried out using the scale supported by the data, i.e. not over-scaled.

G.7.7 Visual requirements

G.7.7.1 Symbols (G.4.2)

- a) Check that the symbols and navigational elements are based on the IHO recommendations.
- b) Check that it is possible to display own ship at least as a symbol of constant size.
- c) Check that the colours displayed are agreeable with the IHO recommendations.

G.7.7.2 Display characteristics (G.4.1, G.4.2.2)

Measure the displayed chart area while in route monitoring mode and check that it is at least 270 mm by 270 mm.

Check that in route monitoring mode any windows superimposed on the chart display area are removable or can be removed.

Check that a mariner's information panel on the same screen as the route monitoring display uses the "user interface" colours from the presentation library colour tables or clearly visible colours which do not detract from the chart display in any of the five mandatory colour tables and can be accepted as equivalent to the "user interface" colours.

G.7.8 Functional requirements (G.3.1.5)

The following tests shall be performed both in route planning and route monitoring mode. The initial latitude/longitude position shall be that provided in the instruction manual for the IHO test data set. For all tests, confirm that there is no degradation in information content.

G.7.8.1 Chart display information (G.3.1.1, G.3.1.4)

Follow manufacturer's instructions to reinitialise the EUT as if power had never been applied. Turn off the EUT and turn the EUT back on. Re-enter the initial latitude/longitude position. Confirm that the largest scale chart for the displayed area can be shown.

Verify by visual inspection that the back-up system can display all the information required in G.3.1.4 of this standard including identification of dangers and aids to navigation, and additional chart information if applicable.

G.7.8.2 Scale and navigation purpose (G.3.1.7)

- a) Select a chart and display the information at a larger scale (overscale) by zooming in, and ensure that an indication is provided.
- b) Select a smaller scale chart that includes own ship's position, covered by a larger scale chart, and ensure that an indication is provided.

G.7.8.3 Mode and orientation (G.3.1.9)

- a) If a presentation mode other than north up is available, check that the orientation of the screen is clearly indicated.
- b) Ensure that true motion is provided. Reset the display and check that the generation of the neighbouring area takes place automatically at a distance selected by the mariner.
- c) Check that it is possible to change manually the chart area and the position of own ship relative to the edge of the display.

G.7.8.4 Navigation related functions (G.3.1.3.5 / annex B)

Verify that at least one EBL and one VRM are available. Ensure that all the other symbols required for navigation purposes and specified in annex B are available.

G.7.8.5 Position integration (G.3.1.3.1 / G.6.1.1)

- a) Connect a simulated position input to the EUT and verify that the correct position is displayed.
- b) Adjust the position manually. Observe that the amount of the correction is displayed on the screen and that the position changes accordingly. Recheck periodically to see it remains unchanged.

G.7.8.6 Radar and plotting information (G.3.1.8)

Where the capability for displaying radar and plotting information is provided:

- a) observe the display without radar overlay, switch on the radar overlay and plotting information and ensure that the chart information is not degraded, and is clearly distinguished;
- b) observe the display without radar, then switch on the radar overlay and plotting information and ensure that these match in scale, orientation, projection and accuracy, within the ranges defined in the relevant standards. Check that a change of scale of the radar, if it is a separate unit, does not affect the chart/radar image in scale, orientation projection and accuracy;
- c) ensure that the displayed position of the ship may be adjusted manually;
- d) note that the accumulated offset is clearly indicated;
- e) ensure that the radar and plotting information may be removed by single operator actions;
- f) set EUT to accept and display transferred plotting targets. Set the simulator to the equivalent of stabilized, north-up mode and to 12-mile range. Check that the target information is being accepted and displayed correctly;
- g) vary the radar antenna offset and confirm that the position of radar overlay and plotting information on the EUT changes accordingly.

For this test a radar target in a fixed position shall be simulated.

G.7.8.7 Updates (G.3.1.6)

Verify that updates on the ECDIS can be duplicated on the EUT and that the EUT can be manually updated.

G.7.8.8 Self-tests of major functions (G.3.3)

- a) Perform tests of the major functions, which are supported by the EUT. Verify that the EUT provides appropriate display information and indications.
- b) Simulate the following sensor malfunctions (including for radar if provided for):
 - 1) interruption of sensor input (loss of signal);
 - 2) invalid sensor information (status);
 - 3) physical breakdown of sensor connection.
- c) Verify that the system provides suitable alarms and indication of system malfunction arising from failures in accordance with the relevant standard.

G.7.9 Operational requirements**G.7.9.1 Ergonomic principles** (G.4.1)

- a) The EUT shall comply with the ergonomic principles noted in IEC 60945.
- b) The acoustic alarm level must be capable of the maximum defined in IEC 60945 but may be adjustable below this limit.

G.7.9.2 Route planning (G.3.1.2)

- a) Test that the route plan can be transferred from ECDIS to the EUT after completion of the route plan. Alter the route plan on ECDIS and transfer alterations/new route to the EUT and check that the previous route is corrected/overwritten.

- b) Test that route plans can be planned and can be adjusted manually.
- c) For the routes to be planned as described below, the following general guidelines apply:
 - 1) least one leg of the route shall be planned through an area of the chart test data at a different scale. Set to test the 5 s maximum redraw;
 - 2) course changes shall be made, both to starboard and port, between different legs of the route and shall vary from 5° up to 175°;
 - 3) the length of the legs shall vary from 0,5 nautical mile to at least 3 nautical miles with a total length of at least 25 nautical miles;
 - 4) planned speed shall vary between 5 knots and 15 knots;
 - 5) the planned route shall cross at least 3 different scales of chart data.
- d) Observe that the displayed information for route planning, route monitoring and supplementary navigation tasks, such as pilotage or chart work is available.
- e) Plan a route which uses at least 10 waypoints:
 - 1) add three waypoints;
 - 2) delete three waypoints;
 - 3) change position of two waypoints;
 - 4) change order of waypoints in the route;save the alternate route.

G.7.9.3 Route monitoring (G.3.1.3.3 and G.3.1.3.4)

- a) Verify that the planned route is displayed with both straight and curved segments.
- b) Using the chart test data set select an automatic time interval, in a range 1 min to 120 min: simulate the vessel's movement, and verify that the time labels are displayed. Ensure that time labels may also be entered manually.

G.7.9.4 Twelve-hour log (G.3.1.10)

Ensure that the record for the previous 12 hours and the voyage track, once recorded, can be preserved.

G.7.9.5 Voyage record (G.3.1.10)

Verify that the EUT records the track for the entire voyage, with time marks at intervals not exceeding 4 hours.

G.7.9.6 Power supply (G.5)

- a) Check that the EUT can be powered from a separate supply other than the ECDIS. Switch off the power supply to the ECDIS. Verify that the EUT continues to function.
 - b) Interrupt the power supply for 45 s, and ensure that the EUT does not need to be re-initialised manually.
 - c) Operator settings shall be checked that they have not changed.
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Annex H (normative)

RCDS mode of operation

NOTE – In sub clauses of H.1 through H.15 of annex H, the text in italics is from the corresponding paragraph of appendix 7 of IMO resolution A.817. The paragraphs of appendix 7 of A.817 indicate whether the paragraphs of clauses 1 through 4 apply to the RCDS mode. When a paragraph applies, the text in italics is from that paragraph, modified for RCDS mode by substituting RNC for ENC and SRNC for SENC, when appropriate. For example, sub clause H.1.2 is paragraph 1.2 from appendix 7 of A.817 and sub clause H.3.1 is paragraph 3.1 from A.817 (since paragraph 3.1 from appendix 7 simply states "Paragraph applies to RCDS")

H.1 Introduction

H.1.1 *The primary function of the ECDIS is to contribute to safe navigation.*

H.1.2 *When operating in the RCDS mode, ECDIS shall be used together with an appropriate portfolio of up-to-date paper charts.*

H.1.3 *In addition to the general requirements for shipborne radio equipment forming part of the global maritime distress and safety system (GMDSS) and the requirements for electronic navigational aids contained in IMO resolution A.694 (IEC 60945), ECDIS, when operating in the RCDS mode, shall meet the requirements of appendix 7 of IMO resolution A.817.*

H.1.4 *ECDIS shall be capable of displaying all chart information necessary for safe and efficient navigation originated by, and distributed on the authority of, government-authorized hydrographic offices.*

H.1.5 *When operating in the RCDS mode, ECDIS shall facilitate simple and reliable updating of the raster navigational chart.*

H.1.6 *Use of ECDIS shall reduce the navigational workload as compared to use of the paper chart. It shall enable the mariner to execute in a convenient and timely manner all route planning, route monitoring and positioning currently performed on paper charts. It shall be capable of continuously plotting the ship's position.*

H.1.7 *ECDIS shall have at least the same reliability and availability of presentation as the paper chart published by government authorized hydrographic offices.*

H.1.8 *ECDIS, when operating in the RCDS mode, shall provide appropriate alarms or indications with respect to the information displayed or malfunction of the equipment. (See annex H.)*

H.2 RCDS definitions

For the purpose of this standard:

H.2.1 *Raster Chart Display System (RCDS) mode means an ECDIS displaying RNCs with positional information from navigation sensors to assist the mariner in route planning and route monitoring and, if required, display additional navigation-related information.*

H.2.2 *Raster Navigational Chart (RNC) means a facsimile of a paper chart originated by, or distributed on the authority of, a government-authorized hydrographic office. RNC is used in these standards to mean either a single chart or a collection of charts.*

The content, structure and format of the RNC are specified in S-61.

H.2.3 *System Raster Navigational Chart Database (SRNC) means a database resulting from the transformation of the RNC by the RCDS to include updates to the RNC by appropriate means.*

H.2.4 – H.1.2.5 *Paragraphs do not apply to RCDS mode.*

H.2.6 *Further information on ECDIS definitions may be found in S-52, appendix 3.*

NOTE – S-52 appendix 3 has not yet been updated to include RCDS related terms.

H.3 Display of SRNC information

H.3.1 *When operating in the RCDS mode, ECDIS shall be capable of displaying all SRNC information. (See H.17.2.1.)*

H.3.2 *SRNC information available for display during route planning and route monitoring shall be subdivided into two categories:*

- .1 the RCDS mode standard display consisting of RNC and its updates, including its scale, the scale at which it is displayed, its horizontal datum, and its units of depths and heights; and (See H.17.2.1 and H.17.4.2.)*
- .2 any other information such as mariner's notes. (See H.17.5.1.)*

H.3.3 *When operating in the RCDS mode, ECDIS shall present the RCDS mode standard display at any time by a single operator action.*

Standard display for RCDS mode is defined in H.3.2.1.

The chart should be displayed at the resolution contained in the RNC. Supplementary operator action may be necessary to access information contained in notes, diagrams, etc., that are not located on the portion of the chart currently being displayed. (See H.16.5.)

H.3.4 *When an RNC is displayed on ECDIS, it shall provide an indication advising the mariner if a more detailed (larger scale) RNC is available for the displayed area. (See H.17.5.2c.)*

H.3.5 *It shall be easy to add to, or remove from the display, any information additional to the RNC data, such as mariner's notes. It shall not be possible to remove any information from the RNC. (See H.17.5.1a.)*

H.3.6-H.3.7 *Paragraphs do not apply to RCDS mode.*

H.3.8 *The RNC and all updates to it shall be displayed without any degradation of their information content. (See H.17.4.1a, H.17.5.9 and H.17.5.10.)*

Degradation shall be understood as degradation in information quantity as well as quality with respect to a standard test chart or charts provided by government authorised hydrographic offices when displayed at the resolution contained in the RNC.

H.3.9 *When operating in the RCDS mode, ECDIS shall provide a method of ensuring that the RNC and all updates to it have been correctly loaded into the SRNC. (See H.17.5.9 and H.17.5.10.)*

H.3.10 *The RNC data and updates to it shall be clearly distinguishable from other displayed information, such as, for example, that listed in annex B. (See H.17.5.1a.)*

RNC colours are specified by the government authorized hydrographic office (S-61 3.4.2.17, 3.4.2.17.1 and 3.4.2.17.2).

H.3.11 *There shall always be an indication if ECDIS is operating in RCDS mode. (See H.17.2.1.)*

H.4 Provision and updating of chart information

H.4.1 *The RNC used in ECDIS shall be the latest edition of that originated by, or distributed on the authority of, a government-authorized hydrographic office and conform to Standards (S-61). RNCs not on WGS-84 or PE-90 shall carry meta-data (i.e. additional data) to allow geo-referenced positional data to be displayed in the correct relationship to SRNC data. (See H.17.2.1 and H.17.5.6.)*

The value of the shift between RNC geodetic datum and WGS-84 or PE-90 contained in the meta-data may be “shift not known”. This should be indicated on the display.

In order to identify the date and origin of the RNC in use, the ECDIS shall include a graphical index of RNC data available, presented upon the mariner's request and providing access to the edition and date of each.

A new edition of an RNC will supersede a previous RNC and its integrated updates issued by a government-authorized hydrographic office.

H.4.2 *The contents of the SRNC shall be adequate and up-to-date for that part of the intended voyage not covered by ENC.*

NOTE – References to updates in H.1.4.3 through H.1.4.8 refer either to individual updates or to collections of individual updates issued together at regular intervals, for example weekly.

H.4.3 *It shall not be possible to alter the contents of the RNC.*

H.4.4 *Updates shall be stored separately from the RNC.*

Separate storage of updates may utilize the same data storage area.

H.4.5 *When operating in the RCDS mode, ECDIS shall be capable of accepting official updates to the RNC data provided in conformity with Standards. These updates shall be automatically applied to the SRNC. By whatever means updates are received, the implementation procedure shall not interfere with the display in use. (See H.17.5.9.)*

The contents of an update assume that all earlier updates have been applied to the SRNC. A new edition of an RNC shall supersede a previous RNC and its updates.

H.4.6 *When operating in the RCDS mode, ECDIS shall also be capable of accepting updates to the RNC data entered manually with simple means for verification prior to the final acceptance of the data. They shall be distinguishable on the display from RNC information and its official updates and not affect display legibility. (See H.17.5.10.)*

H.4.7 *ECDIS shall keep a record of updates including time of application to the SRNC. (See H.17.5.9 and H.17.5.10.)*

The record shall include updates for each RNC until it is superseded by a new edition.

H.4.8 *ECDIS shall allow the mariner to display updates so that the mariner may review their contents and ascertain that they have been included in the SRNC. (See H.17.5.9 and H.17.5.10.)*

H.5 Scale

When operating in the RCDS mode, *ECDIS* shall provide an indication if:

- .1 *the information is displayed at a different scale than that contained in the RNC; or* (See H.17.5.2a and b.)

Overscale means displaying the RNC at a greater resolution (more pixels per mm) than that contained in the RNC. Underscale means displaying the RNC at a lesser resolution (fewer pixels per mm) than that contained in the RNC.

- .2 *own ship's position is covered by an RNC at a larger scale than that provided by the display.* (See H.17.5.2c.)

H.6 Display of other navigational information

H.6.1 *Radar information or other navigational information may be added to the ECDIS display. However, it shall not degrade the SRNC information, and shall be clearly distinguishable from the SRNC information.* (See H.17.5.1 and H.17.5.8.)

H.6.2 *ECDIS and added navigational information shall use a common reference system. If this is not the case, an indication shall be provided.* (See H.17.5.1, H.17.5.6 and H.17.5.7.)

Such advice shall be included in the manufacturer's installation handbook.

H.6.3 Radar and plotting information

H.6.3.1 *Transferred radar information may contain both the radar image and ARPA or ATA or EPA information.* (See H.17.5.7.)

Where plotting information is added it shall be indicated to the operator whether the vectors are relative or true, and if true whether they are sea or ground stabilized.

H.6.3.2 *If the radar image is added to the ECDIS display, the chart and the radar image shall match in scale, orientation and projection.* (See H.17.5.7b.)

H.6.3.3 *The radar image and the position from the position sensor shall both be adjusted automatically for antenna offset from the conning position.* (See H.17.5.7g.)

H.6.3.4 *It shall be possible to adjust the displayed position of the ship manually so that the radar image matches the SRNC display.* (See H.17.5.7c.)

If an offset is applied, it shall be clearly indicated. The details of the offset shall be readily available.

H.6.3.5 *It shall be possible to remove the radar or plotting information by single operator action.* (See H.17.5.7e.)

H.7 Display mode and generation of the neighbouring area

H.7.1 *It shall always be possible to display the RNC in 'chart up' orientation. Other orientations are permitted.* (See H.17.5.3a.)

H.7.2 *ECDIS shall provide for true motion mode. Other modes are permitted.* (See H.17.5.3b.)

H.7.3 *When true motion mode is in use, reset and generation of the neighbouring area shall take place automatically at a distance from the border of the display determined by the mariner.* (See H.17.5.3c.)

H.7.4 *It shall be possible to manually change the chart area and the position of own ship relative to the edge of the display. (See H.17.5.3c.)*

H.8 Colours and symbols

H.8.1 *IHO recommended colours and symbols shall be used to represent SRNC information (S-61 3.4.2.17, 3.4.2.17.1 and 3.4.2.17.2). (See H.17.4.3.)*

H.8.2 *The colours and symbols other than those mentioned in H.8.1 shall be those used to describe the navigational elements and parameters listed in annex B and published in annex E.*

H.8.3 *Paragraph does not apply to RCDS mode.*

H.8.4 *ECDIS shall allow the mariner to select whether own ship is displayed in true scale or as a symbol. (See H.17.4.1b.)*

H.9 Display requirements

H.9.1 *When operating in the RCDS mode, ECDIS shall be capable of displaying information for:*

- .1 route planning and supplementary navigation tasks; (See H.17.6.2.)*
- .2 route monitoring. (See H.17.6.3.)*

H.9.2 *The effective size of the chart presentation for route monitoring shall be at least 270 mm by 270 mm. (See 6.7.5.)*

H.9.3 *Paragraph does not apply to RCDS mode.*

H.9.4 *The method of presentation shall ensure that the displayed information is clearly visible to more than one observer in the conditions of light normally experienced on bridge of the ship by day and by night. (See H.17.4.4.)*

H.9.5 *When operating in the RCDS mode, ECDIS shall be capable of displaying, simply and quickly, chart notes which are not located on the portion of the chart currently being displayed (S-61 3.4.2.18 and 3.4.2.19). (See H.17.2.1.1b.)*

"Simply and quickly" denotes not more than three operator actions.

H.10 Route planning, monitoring and voyage recording

H.10.1 *It shall be possible to carry out route planning and route monitoring in a simple and reliable manner. (See H.17.6.2 and H.17.6.3.)*

H.10.2 *ECDIS shall be designed following ergonomic principles for user-friendly operation in RCDS mode. (See H.17.6.1.)*

H.10.3 *Paragraph does not apply to RCDS mode.*

H.10.4 Route planning

H.10.4.1 *It shall be possible to carry out route planning including both straight and curved segments. (See H.17.6.2.)*

H.10.4.2 *It shall be possible to adjust a planned route by, for example: (See H.17.6.2.)*

- .1 adding waypoints to a route;
- .2 deleting waypoints from a route;
- .3 changing the position of a waypoint;
- .4 changing the order of the waypoints in the route.

H.10.4.3 *It shall be possible to plan an alternate route in addition to the selected route. The selected route shall be clearly distinguishable from the other routes. (See H.17.6.2.)*

H.10.4.4-H.10.4.5 *Paragraphs do not apply to RCDS mode.*

H.10.4.6 *It shall be possible for the mariner to specify a limit of deviation from the planned route at which activation of an automatic offtrack alarm shall occur. (See H.17.6.2.)*

H.10.4.7 *It shall be possible for the mariner to enter points, lines and areas which activate an automatic alarm. The display of these features shall not degrade the SRNC information and shall be clearly distinguishable from the SRNC information. (See H.17.5.1b and H.17.5.4.)*

This is the mechanism used by the mariner to enable the RCDS to emulate the alarms and warnings automatically generated by ENC data in the ECDIS.

H.10.5 Route monitoring

H.10.5.1 *For route monitoring the selected route and own ship's position shall appear whenever the display covers that area. (See H.17.6.3.)*

H.10.5.2 *It shall be possible to display a sea area that does not have the ship on the display (e.g. for look ahead, route planning), while route monitoring. If this is done on the display used for route monitoring, the automatic route monitoring functions in H.1.10.4.6 and H.1.10.4.7 shall be continuous. It shall be possible to return to the route monitoring display covering own ship's position immediately by single operator action. (See H.17.6.3.)*

Route monitoring will only provide automatic alarms and indications if the mariner has entered the appropriate data in H.1.10.4.6 and H.1.10.4.7.

H.10.5.3-H.1.10.5.4 *Paragraphs do not apply to RCDS mode.*

H.10.5.5 *An alarm shall be given when the specified limit for deviation from the planned route is exceeded. (See H.17.6.3.)*

H.10.5.6 *The ship's position shall be derived from a continuous positioning system of an accuracy consistent with the requirements of safe navigation. Whenever possible, a second independent positioning method of a different type shall be provided; ECDIS shall be capable of identifying discrepancies between the two systems. (See H.17.5.6.)*

The ECDIS shall have means to display the position from at least two positioning methods, to identify which method is being used, and provide a means for the operator to select the method he wants to use. Secondary positioning methods could include dead reckoning.

H.10.5.7 *ECDIS shall provide an alarm when the input from the electronic position-fixing system is lost. ECDIS shall also repeat, but only as an indication, any alarm or indication passed to it from an electronic position-fixing system. (See H.17.5.6.)*

H.10.5.8 *An alarm shall be given by ECDIS if the ship, within a specified time or distance set by the mariner, is going to reach a critical point on the planned route.*

ECDIS shall permit the mariner to define critical points and the time or distance at which an alarm shall be given. The words “to reach a critical point” shall be considered passing abeam of the critical point on the planned route.

H.10.5.9 When operating in the RCDS mode, ECDIS shall *only accept data* from an electronic position-fixing system *referenced to the WGS-84 or PE-90 geodetic datums* as appropriate for the SRNC in use. ECDIS shall *give an alarm if the positional data is not referenced to that same geodetic datum as the SRNC in use.* (See H.1.4.1 and H.17.5.6.)

H.10.5.10 *It shall be possible to display an alternate route in addition to the selected route. The selected route shall be clearly distinguishable from the other routes. During the voyage, it shall be possible for the mariner to modify the selected route or select an alternate route.* (See H.17.5.5, H.17.6.3 and annex B.)

H.10.5.11 *It shall be possible to display:*

- .1 time-labels along ship's track manually on demand and automatically at intervals selected between 1 and 120 minutes; and* (See H.17.5.5, H.17.6.3 and annex B.)
- .2 an adequate number of: points, free movable electronic bearing lines (EBL), variable range markers (VRM), fixed range markers and other symbols required for navigation purposes and specified in annex B.* (See H.17.5.5.)

An “adequate number” of EBL and VRM implies at least one of each.

H.10.5.12 *It shall be possible to enter the geographic coordinates of any position and then display that position on demand. It shall also be possible to select any point (feature, symbol or position) on the display and read its geographic co-ordinates on demand.* (See H.17.5.4 and H.17.5.5.)

H.10.5.13 *It shall be possible to adjust the ship's geographic position manually. This manual adjustment shall be noted alpha-numerically on the screen, maintained until altered by the mariner, and automatically recorded.* (See H.17.5.6f.)

H.10.5.14 When operating in the RCDS mode, ECDIS shall *allow the user to manually align the SRNC with positional data. This can be necessary, for example, to compensate for local charting errors.* (See H.17.5.6f.)

H.10.5.15 When operating in RCDS mode, ECDIS shall *give an alarm if the ship, within a specified time or distance set by the mariner, is going to cross a point, line or boundary of a feature entered by the mariner and specified for an automatic alarm in H.1.10.4.7.* (See H.17.5.1b, H.17.5.4 and H.17.6.3.)

H.10.6 Voyage recording

H.10.6.1 When operating in the RCDS mode, ECDIS shall *store and be able to reproduce certain minimum elements required to reconstruct the navigation and verify the official database used during the previous 12 hours. The following data shall be recorded at one minute intervals:* (See H.17.6.4.)

- .1 to ensure a record of own ship's past track: time, position, heading and speed; and*
- .2 to ensure a record of official data used: RNC source, edition, date, and update history*

H.10.6.2 *In addition, ECDIS shall record the complete track for the entire voyage, with time marks at intervals not exceeding 4 hours.* (See H.17.6.5.)

For the purposes of logging, the entire voyage is defined as a maximum period of three months.

H.10.6.3 *It shall not be possible to manipulate or change the recorded information.* (See H.17.6.4 and H.17.6.5.)

H.10.6.4 *ECDIS shall have a capability to preserve the record of the previous 12 hours and of the voyage track. (See H.17.6.4.)*

H.11 Accuracy

H.11.1 *When operating in the RCDS mode, the accuracy of all calculations performed by ECDIS shall be independent of the characteristics of the output device and shall be consistent with the scale of the SRNC. (See H.17.3.)*

The output device includes ECDIS display, stored memory, and/or printout.

H.11.2 *Bearings and distances drawn on the display, or those measured between features already drawn on the display shall have an accuracy consistent with the resolution of the display but no more than that afforded by the scale of the SRNC. (See H.17.3.)*

H.12 Connections with other equipment (Interfaces)

(See IEC 61162 series.)

H.12.1 *ECDIS shall not degrade the performance of any equipment providing sensor inputs. Nor shall the connection of optional equipment degrade the performance of ECDIS below this standard. (See 6.2.)*

H.12.2 *ECDIS shall be connected to systems providing continuous position fixing, heading and speed information. (See 6.2.)*

H.13 Performance tests, malfunction alarms and indications

H.13.1 *ECDIS shall be provided with means for carrying out on-board tests of major functions either automatically or manually. In case of a failure, the test shall display information to indicate which module is at fault. (See 6.8.17.)*

On board tests of major functions include the integrity of sensor input. If there is any detectable reason why the information presented to the operator is invalid, adequate and clear warnings shall be given to the operator. This clarification is consistent with annex 4 to IMO resolution MSC.64.

H.13.2 *ECDIS shall provide suitable alarm or indication of system malfunction. (See 6.8.17.)*

H.14 Back-up arrangements

Adequate independent back-up arrangements shall be provided to ensure safe navigation in case of an ECDIS failure: (See annex G.)

- .1 Facilities enabling a safe take-over of the ECDIS functions shall be provided in order to ensure that an ECDIS failure does not result in a critical situation.*
- .2 A back-up arrangement shall be provided facilitating means for safe navigation of the remaining part of the voyage in case of an ECDIS failure.*

H.15 Power supply

H.15.1 *It shall be possible to operate ECDIS and all equipment necessary for its normal functioning when supplied by an emergency source of electrical power in accordance with the appropriate requirements of regulation II/1 of the 1974 SOLAS convention.*

H.15.2 *Changing from one source of power supply to another, or any interruption of the supply for a period of up to 45 seconds, shall not require the equipment to be re-initialized manually. (See 6.9.6.)*

The equipment is not required to remain operational during this interruption of the power supply.

Table 1

Alarms and indicators in the RCDS mode of operation

Sub Clause	Requirement	Information
H.10.4.6	Alarm	Exceeding off track limits
H.10.4.7	Alarm	Approach to mariner-entered <i>point, line, area or feature</i>
H.10.5.5	Alarm	Deviation from route
H.10.5.7	Alarm	Positioning system failure
H.10.5.8	Alarm	Approach to critical point
H.10.5.9	Alarm	Different geodetic datum
H.10.5.15	Alarm	Approach to mariner-entered <i>point, line or feature</i>
H.13.2	Alarm or indication	Malfunction of ECDIS
H.3.4	Indication	Larger scale RNC available
H.3.11	Indication	ECDIS operating in RCDS mode
H.5.1	Indication	Information overscale or underscale
H.5.2	Indication	Larger scale RNC available
H.6.2	Indication	Different reference system for added navigation information
H.13.1	Indication	System test failure

The definitions of alarms and indicators are given in annex D.

H.16 Requirements contained in IHO special publications

H.16.1 Structure of RNC data

This product specification does not define underlying raster data structures of a raster navigational chart. The national hydrographic office producing the raster navigational chart should select that data structure. (S-61/1.2)

The arrangement of the image data and the meta-data into one or more digital files should be determined by the national hydrographic offices originating the RNC. (S-61/3.2)

The digital format of the image file shall be determined by the national hydrographic office producing the RNC. (S-61/3.3.1)

The digital format of the meta-data shall be determined by the national hydrographic office originating the RNC. (S-61/3.4.1)

For the purpose of this document it is assumed that the range of different RNC formats or structures will be notified by the IHB. There are currently only two RNC formats or structures in use: HCRF (used by, for example, UKHO ARCS and Australian HO Seafarer) and the USA BSB. The IHB has recommended that no other RNC formats be used.

H.16.2 RNC data resolution and accuracy

The resolution of the digital image (pixels-per-inch) and any method used to compress or process that image file shall be sufficient to display clearly all information that was contained on the original paper nautical chart. In particular, methods such as antialiasing shall be employed to achieve maximum contrast and fidelity of displayed chart information compared to the printed chart. (S-61/3.3.2) (See H.17.4.1a and H.17.4.4.)

The accuracy of the digital image file, as measured by the ability to determine the correct geographic coordinates of an individual pixel when the image file is used together with the RNC meta-data, shall allow a ship's position to be displayed at least as accurately as when using the original paper chart. (S-61/3.3.3) (See H.17.2.1.1a)

H.16.3 RNC meta-data

Where an image file contains more than one discrete chart image, e.g. chart insets, in addition to the main panel of the chart the meta-data shall be included for each such discrete chart image. (S-61/3.4.2 and 3.5.1)

H.16.4 RNC colours

Colours used for daytime viewing shall be those used on the paper versions of the same charts. (S-61/3.4.2.17.1)

Colours for dusk and night-time shall follow as closely as practicable the Colours and Symbols Standards specified in IHO Special Publication S-52, Appendix 2. (S-61/3.4.2.17.2)

Colour palettes for daytime, dusk and night-time are specified in the RNC meta-data by the issuing HO. (See H.17.4.3.)

H.16.5 RNC notes, diagrams, etc

Sufficient information (should be included) which will allow each note, diagram, item of marginalia or other chart subarea of special interest to be found and displayed clearly, simply and quickly even though that subarea may not be located on the portion of the chart currently being displayed. (S-61/3.4.2.18) (See H.17.2.1.1b.)

Sufficient information (should be included) to allow any source diagram, which provides information about data quality, to be displayed clearly, simply and quickly even though the source diagram may not be located on the portion of the chart currently being displayed. (S-61/3.4.2.19) (See H.17.2.1.1b.)

It would be sufficient to provide an index or listing of notes, etc applicable to the RNC.

H.17 Methods of testing and required test results

NOTE - This clause lists tests and required test results which are specific to the RCDS mode of operation. These are additional to the general ECDIS and ENC specific tests and test results contained in clause 6.

H.17.1 Preparation

H.17.1.1 Required test items (H.4.1 / H.16.1)

For the purpose of these tests the following items shall be used:

- Test RNCs as specified by the HO providing the RNC service or on whose behalf the RNC service is provided.

The Test RNC must give examples of the full range of colours used on the source paper charts of the HO providing the RNC service or on whose behalf the RNC service is provided.

- RNCs are currently provided using either the HCRF format or the BSB format. Equipment testing can relate to the HCRF format, the BSB format or both formats. Type approval will only be valid for the format or formats tested.

H.17.2 Initial data tests

H.17.2.1 RNC (H.3.11 / H.17.4.2)

Load a test RNC and ensure that:

- a) the RCDS mode indication is displayed.
- b) the edition number and date of the RNC is displayed in the chart library.
- c) Verify that a graphical index of RNC data available can be presented upon request and provide access to the edition and date of the RNCs available.
- d) Load an additional RNC and ensure that the chart coverage has changed and that the chart library is updated.
- e) Remove an RNC and ensure that the chart coverage has changed and that the chart library is updated.
- f) Switch to ENC mode and observe that the RCDS mode indication is no longer displayed.

H.17.2.1.1 Datum (H.9.5 / H.10.5.12 / H.16.2 / H.16.5)

- a) Enter the geographic coordinate of a position, and display that position. Select a point, which may be a charted symbol or a position and display its geographic coordinate. When the RNC is based on a local geodetic datum, the system must give an indication of whether that position is displayed with respect to the local geodetic datum or WGS-84 (PE-90) where the shift between the two datums is contained in the RNC.
- b) Select a note or diagram contained in the RNC which does not appear on the portion of the RNC currently being displayed. Ensure that the note or diagram can be displayed quickly and easily. If this requirement is met by displaying the area of the chart which contains the note or diagram, ensure that it is possible to return to the original area quickly and easily.
- c) Load an RNC for which the shift between geodetic datum and WGS-84 or PE-90 is specified in the RNC meta-data as “shift not known” and ensure that an indication is provided.

H.17.3 Accuracy (H.11.1 / H.11.2)

The test shall verify:

- the accuracy of EUT calculations consistent with SRNC;
 - the measurement accuracy consistent with display resolution.
- a) Perform the measurements provided for in the RNC test data and confirm that they meet the required accuracy. Check that the system can perform the following calculations:
 - transformation between a local datum and WGS-84;
 - true distance and azimuth between two geographical positions;
 - geographic position from known position and distance/azimuth;
 - rhumb line and great circle.
 - b) Calculate and display both a rhumb line and a great circle line and verify that no visible distortion exists between these lines and the chart data. Use for this test Scenario 1 noted in the annex J.

This test shall be carried out using the scale supported by the data, i.e. not over-scaled.



H.17.4 Visual requirements

H.17.4.1 Visual display (H.16.2)

- a) Check that the image is a faithful representation of the paper chart provided by the HO with the test data set.
- b) Check that it is possible to display own ship in true scale or as a symbol.

H.17.4.2 Units and legends

Check that the following elements can be determined easily and rapidly:

- a) RNC number;
- b) chart identifier (e.g. chart number) if different from RNC number;
- c) units for depth;
- d) units for height;
- e) RNC scale;
- f) scale of display;
- g) source data diagram (if available);
- h) sounding/vertical datum;
- i) horizontal datum;
- j) magnetic variation;
- k) date and number of last update affecting the RNC currently in use;
- l) edition number and date of issue of the RNC;
- m) chart projection.

H.17.4.3 Colour tables (H.8.1 / H.16.4)

Verify that the colour palettes for daytime, dusk and night-time viewing, and which are specified in the RNC meta-data, can be used.

H.17.4.4 Display characteristics (H.9.2 / H.9.4)

Ensure that when displayed at the resolution specified in the RNC meta-data, information is clearly visible to more than one observer, in the conditions of light normally experienced on the bridge of the ship by day and by night.

Verify that in route monitoring mode any windows superimposed on the chart display area are removable or can be moved.

H.17.5 Functional requirements

The following tests shall be performed both in route planning and route monitoring mode. The initial latitude/longitude position shall be that provided in the instruction manual for the specific RNC test data set. For all tests, confirm that there is no degradation in information content.

Follow manufacturer's instruction to reinitialize EUT in RCDS mode of operation as if power had never been applied. Turn off EUT and turn EUT back on. Re-enter the initial latitude/longitude position. The initial position may be fed via a serial interface to the EUT. Confirm that the scale displayed conforms to the largest scale available in the SRNC for the displayed area.

H.17.5.1 Additional display functions (H.3.5 / H.10.4.7)

- a) Verify that it is easy to add to, or remove from, the EUT display information additional to the RNC data such as mariner's notes. Verify that such information is clearly distinguishable from the RNC data.

- b) Verify that it is possible for the mariner to add and save mariner-entered points, lines and areas. Verify that it is possible to amend and delete mariner entered points, lines and areas. Check that examples of those items like 10 lines, 25 text characters and two areas can be drawn at user defined locations. Check that all information added by the mariner is distinguishable as described in S-52 appendix 2/2.3.1b, except for colour fill. Check that one of the areas can be filled, as described in S-52 appendix 2/2.3.1b. Check that all of these objects (symbols) can be added to the system and set up for cursor picking to give an explanatory note in the text display. Recall them from the system and check that they may be deleted.
- c) If the manufacturer displays information, check that the presentation of the information conforms with the following:
 - 1) the caution (!) or information (i) symbol is used to call up a note on the alphanumeric display by cursor picking;
 - 2) simple lines, or areas without colour fill, are set up for cursor picking to give an explanatory note in the alphanumeric display. Colour fill shall not be used;
- d) Verify that the mariner-entered or manufacturers information appear on charts of other scales which cover the same geographical area.

H.17.5.2 Scale and navigation purpose (H.3.4 / H.5)

- a) Select an RNC and display it at a greater resolution than that contained in the RNC meta-data and ensure that an indication is provided.
- b) Select an RNC and display it at a lesser resolution than that contained in the RNC meta-data and ensure that an indication is provided.
- c) Load two RNCs of different scale which include own ship's position. Select the smaller scale RNC and ensure that an indication is given that a larger scale RNC is available for the displayed area.

H.17.5.3 Mode and orientation (H.7)

- a) Select an RNC which is not orientated "north-up". Verify that it is possible to determine quickly and easily the north direction. Verify that it is displayed "chart up".
- b) Select an RNC. Ensure that true motion is provided. Reset the display and check that the generation of the neighbouring area takes place automatically at a distance selected by the mariner.
- c) Select an RNC. Check that it is possible to change manually the chart area and the position of own ship relative to the edge of the display.

H.17.5.4 Points, lines and areas (H.10.4.7)

Enter examples of mariner-defined points, lines and areas which are intended to trigger alarms and ensure that the alarms are triggered when the vessel reaches the appropriate position.

H.17.5.5 Navigation related functions (4.10.5 / 4.10.5.11 / 4.11.2 / annex B)

Verify that at least one EBL and VRM is available. Ensure that all the other symbols required for navigation purposes and specified in annex B are available.

H.17.5.6 Position integration (H.4.1/ H.10.5.14)

- a) Load an RNC for which the shift between geodetic datum and WGS-84 or PE-90 is specified in the RNC meta-data. Connect a continuous position system to the EUT and verify that the system compensates automatically for this shift when plotting positions on the RNC. Ensure that the reference datum (geodetic datum or WGS-84 (PE-90) being used by the system is clearly indicated.
- b) With a second, independent positioning method ensure that the EUT displays any difference in reported positions.
- c) Remove the positioning input to the EUT and ensure that an indication is given.

- d) Simulate a message from the positioning device which indicates an error condition, and observe that the alarm or indication is repeated by the EUT as an indication.
- e) Select a different geodetic datum between the positioning system and the SRNC, and ensure that an alarm is given.
- f) Adjust the position manually. Observe that the amount of the correction is displayed on the screen and that the position changes accordingly. Recheck periodically to see it remains unchanged.

H.17.5.7 Radar and plotting information (H.6.1 / H.6.3.2 / H.6.3.3)

Where the capability for displaying radar and plotting information is provided:

- a) observe the display without radar overlay, switch on the radar overlay and plotting information and ensure that the SRNC information is not degraded, and is clearly distinguished;
- b) observe the display without radar, then switch on the radar overlay and plotting information and ensure that these match in scale, orientation, projection and accuracy, within the ranges defined in annex 4 to IMO Resolution MSC.64. Check that a change of scale of the radar, if it is a separate unit, does not affect the EUT/radar image in scale, orientation projection and accuracy;
- c) ensure that the displayed position of the ship may be adjusted manually;
- d) note that the accumulated offset is clearly indicated;
- e) ensure that the radar and plotting information may be removed by single operator actions;
- f) set EUT to accept and display transferred plotting targets. Set the simulator to the equivalent of stabilized, north-up mode and to 12-mile range. Check that the target information is being accepted and displayed correctly;
- g) vary the radar antenna offset and confirm that the position of radar overlay and plotting information on the EUT changes accordingly.

For this test a radar target in a fixed position shall be simulated.

H.17.5.8 Loading of corrupted data (H.3.9)

- a) Load an example of corrupted RNC test data. Verify that EUT provides the appropriate warning.
- b) Load the RNC test data set. Enter an example of corrupted update. Verify that EUT reception process is terminated and the update is flagged as invalid. Verify that the user is informed of the corruption.

H.17.5.9 Automatic Updates

H.17.5.9.1 Receipt – installation and application (H.4.5)

- a) Verify that the system can receive updates via appropriate media.
- b) Apply the test update number 1 to the relevant RNC
- c) Identify the issuing authority of the update. Check that this conforms with the corresponding identifier of the RNC.
- d) Attempt to load an improperly sequenced update; check that the update is rejected and that a warning is given to the user.
- e) Attempt to load an update related to a newer edition of RNC; check that the update is rejected and the user is informed that a newer edition is available.
- f) Attempt to load an update related to an older edition of RNC; check that the update is rejected and the user is informed that the update belongs to a previous edition.

H.17.5.9.2 Display – show and verify (H.3.8 / H.3.9 / H.3.10 / H.4.4)

- a) Ensure that the edition date/update number is displayed on request.

- b) Ensure that the contents of the updates have been included in the SRNC, by displaying the SRNC contents and highlighting updates or by some other means allowing the mariner to verify that the updates have been included in the SRNC.
- c) Ensure that official RNC updates can be distinguished from local updates.
- d) Verify that, once accepted, integrated updates are indistinguishable from RNC data.

An update shall be applied to the SRNC, displayed, and then manually annotated as rejected by the mariner, i.e. it shall not be possible for the mariner to reject an officially issued update by omitting its application entirely.

H.17.5.9.3 Records (H.4.7 / H.4.8)

Tests shall be applied in all EUT operating modes, i.e. route planning and route monitoring.

Verify that the following summary report information is available for each RNC:

- a) RNC Number and Chart identifier if different from RNC
- b) RNC edition date;
- c) list of corrections applied subsequent to the edition date;
- d) update and update number
- e) date and time of its application / rejection; and
- f) any anomalies encountered during application.

H.17.5.10 Manual updates (H.4.6)

Using the test data subset, as described in annex I, check that the following manual update procedures may be carried out and that the update is distinguishable from RNC data.

- a) Add new point and restricted area features, locating them at selected positions.
- b) Annotate an existing feature as being deleted.
- c) Check to see that any update text information relevant to the new condition and to the source of the update and entered by the mariner is recorded by the system. Verify that this update can be re-displayed on demand.
- d) Verify that manual updates are distinguishable from RNC data.
- e) Verify that any manual updates removed from the display are retained and can be displayed in a future review.

H.17.5.11 Self-tests of major functions (H.13.1 / H.13.2)

- a) Perform tests of the major functions which are supported by the EUT. Verify that the EUT provides appropriate display information and indications.
- b) Simulate the following sensor malfunctions (including for radar if provided for):
 - .1 interruption of sensor input (loss of signal);
 - .2 invalid sensor information (status);
 - .3 physical breakdown of sensor connection.
- c) Verify that the system provides suitable alarms or indication of system malfunction arising from failures.

H.17.6 Operational requirement

H.17.6.1 Ergonomic principles

- a) The EUT shall comply with the ergonomic principles noted in 5.9 and IEC 60945.
- b) The acoustic alarm level must be capable of the maximum defined in IEC 60945 but may be adjustable below this limit.

H.17.6.2 Route planning (H.9.1 / H.10.1 / H.10.4.1 - H.10.4.3)

- a) For the routes to be planned as described below, the following general guidelines apply:
- .1 at least one leg shall come close enough to a mariner entered point that the automatic alarm would be initiated;
 - .2 at least one leg shall cross a mariner-entered linear feature;
 - .3 at least one leg shall cross the boundary of a mariner-entered area feature;
 - .4 at least one leg of the route shall be planned through an area of the RNC test data at a different scale. The adjoining RNC shall be loaded automatically when planning through the area. Set to test the 5 s maximum redraw;
 - .5 at least one leg of the route shall be planned through a chartlet area of the RNC test data set. The chartlet shall be loaded automatically when planning through the area. Set to test the 5 s maximum redraw;
 - .6 each leg shall be planned with an appropriate off track limit (e.g. 100m);
 - .7 course changes shall be made, both to starboard and port, between different legs of the route and shall vary from 5° up to 175°;
 - .8 the length of the legs shall vary from 0.5 nautical mile to at least 3 nautical miles with a total length of at least 25 nautical miles;
 - .9 planned speed shall vary between 5 knots and 15 knots;
 - .10 the planned route shall cross at least 3 RNCs. Where the appropriate RNC service or services supplies RNCs based on different chart datums, the planned route shall include at least two different chart datums.
- b) Observe that the displayed information for route planing, route monitoring and supplementary navigation tasks, such as pilotage or chart work is available.
- c) Plan a route which uses at least 10 waypoints:
- .1 test that the route can be planned using both straight and curved segments;
 - .2 save the planned route.
- d) Retrieve the planned route and plan an alternate route as follows:
- .1 add three waypoints;
 - .2 delete three waypoints;
 - .3 change position of two waypoints;
 - .4 change order of two waypoints;
 - .5 save the alternate route.
- e) Plan complex tracks using scenarios No. 2 and No. 3 as noted in annex J and save the tracks. Check that track distances comply with those noted in annex J and that no distortions are visible.
- f) Verify that there is an indication showing that the EUT is operating in the EUT mode.

H.17.6.3 Route monitoring (H.9.1 / H.9.2 / H.10.5.1 / H.10.5.2 / H.10.5.5 - H.10.5.8 / H.10.5.10 / H.10.5.11 / H.10.5.14 / H.10.5.15 / H.11.1)

- a) For route monitoring, the following general guidelines apply:
- .1 initialize simulator at the starting position for the planned route;
 - .2 select RNC and select the route;
 - .3 the route shall be planned through an area covered by the RNC test data set;
 - .4 carry out route monitoring using the selected routes and starting at the first waypoint of the route;
 - .5 at least one leg shall cross a mariner-entered linear feature;
 - .6 at least one leg shall cross a mariner-entered area feature;
 - .7 at least one leg shall come close enough to a mariner-entered point that the automatic alarm would be initiated.

- b) Operate the own ship position function, and observe that the display shows own ship's position.
- c) Shortly before the vessel enters an area for which an alarm based on a mariner-entered feature will be released perform the following actions:
 - .1 display a sea area ahead of ship's position and outside present display (look ahead);
 - .2 verify that the appropriate alarms/indications are provided;
 - .3 return to own ship's position by a single operator action and verify that this takes no more than 5 s.
- d) Verify that an alarm is released each time the vessel is going to cross the boundary of a mariner-entered feature, within the time specified by the mariner.
- e) Select an RNC of a smaller scale than that at d) but covering the same area. Simulate crossing over the mariner-entered feature referred to in d). Check that an alarm is generated by EUT.
- f) Using the RNC test data set:
 - .1 simulate own ship's movement from an area covered by one RNC into an adjoining area covered by another RNC. Ensure that each re-draw which occurs until the display is wholly within the different scale area is completed in less than 5 s;
 - .2 select the display of an area not currently displayed, at least 10 nautical miles from own ship position and which is covered by RNC data at a scale different from the one in use. Check that the old display is maintained from the start of the regeneration until the start of re-draw of the new display. An indication shall be given if the regeneration time is more than 5 s;
 - .3 simulate deviation from intended track and verify that the off-track alarm is released;
 - .4 verify that an alarm is released each time, within the time or distance specified, when a critical point has been reached by or is abeam of the ship;
 - .5 display the alternative route and ensure that it is clearly distinguishable from the selected route. Change to the alternative route and verify that this becomes the selected route;
 - .6 modify the selected route by adding a new waypoint;
 - .7 select an automatic time interval, in a range 1 min to 120 min; simulate the vessel's movement, and verify that the time labels are displayed. Ensure that time labels may also be entered manually.
- g) Verify that there is an indication showing that the EUT is operating in the EUT mode.
- h) Reload complex route of scenario No. 2 and start monitoring the route with the first waypoint. Confirm that all waypoint changes, bearings and distances are calculated and displayed correctly during route monitoring.
- i) Reload complex route of scenario No. 3 and start monitoring the route with the first waypoint. Confirm that all waypoint changes, bearings and distances are calculated and displayed correctly during route monitoring.

H.17.6.4 Twelve-hour log (H.10.5.13 / H.10.5.14 / H.10.6.1 / H.10.6.3 / H.10.6.4)

- a) For voyage recording a separate test route plan shall be made. The route plan shall be designed as a loop. It shall be possible for the simulator to carry out this test automatically.
- b) Continue to run the test for 12 h. During this period, attempts should be made to manually edit the log. This shall not be possible. At the end of the twelve-hour period, the EUT log shall then be analysed according to the procedures in the operating manual and the results shall comply with the test carried out.

Ensure that the record for the previous 12 h including all the items defined in H.10.5.13 and H.10.6.1, is stored and available on demand. Check that chart data according to H.10.6.1 and H.10.6.2 is stored initially and for each change.

H.17.6.5 Voyage record (H.10.6.2-7.10.6.4)

- a) Verify that the EUT records the track for the entire voyage, with time marks at intervals not exceeding 4 h, including the items listed in 4.10.6.1.
- b) Ensure that the record for the previous 12 h and the voyage track, once recorded, can be preserved, and that it is not possible to manipulate or change the recorded information.

H.17.6.6 Power supply (H.15.2)

Interrupt the power supply for 45 s, and ensure that the equipment does not need to be re-initialized manually.

Operator settings shall be checked that they have not changed.

H.18 RNC test data set

In development.

Annex I (normative)

Scenario definitions and plots

Scenario 1:

Rhumb Line / Great Circle Atlantic Track (Boston to Rotterdam) with Ship class B (200 m / 20 kt)

Waypoint No.	Latitude	Longitude	Track [deg]	Distance [NM]	Radius [NM]	R.o.T. [deg/min]
001	42:20.639 N	071:00.786 W	132.1	0.82	0.5	40
002	42:20.090 N	070:59.964 W	112.1	0.40	0.5	40
003	42:19.940 N	070:59.465 W	087.0	1.44	0.5	40
004	42:20.015 N	070:57.525 W	063.6	0.93	0.5	40
005	42:20.429 N	070:56.397 W	026.6	1.77	0.5	40
006	42:22.011 N	070:55.325 W	065.9	0.90	0.5	40
007	42:22.380 N	070:54.210 W	079.5	4.92	0.5	40
008	42:23.275 N	070:47.663 W	065.1	9.53	1.0	20
009	42:27.287 N	070:35.953 W	088.2	126.4	1.0	20
010	42:31.223 N	067:44.616 W	085.4	272.9	1.0	20
011	42:53.045 N	061:34.463 W	065.2	202.7	1.0	20
012	44:17.923 N	057:20.346 W	067.1	307.8	1.0	20
013 Great Circle Approximation	46:17.898 N	050:37.294 W	067.1	1761.2	1.0	20
	48:47 N	40:00 W	075.0			
	50:05 N	30:00 W	082.5			
	50:29 N	20:00 W	090.0			
	50:01 N	10:00 W	098.0			
014	49:38.074 N	006:25.031 W	084.5	147.4	1.0	20
015	49:52.252 N	002:37.903 W	074.5	144.2	1.0	20
016	50:30.788 N	000:59.106 E	049.7	18.33	1.0	20
017	50:42.637 N	001:21.152 E	016.3	13.03	1.0	20
018	50:55.140 N	001:26.929 E	038.1	19.59	1.0	20
019	51:10.551 N	001:46.164 E	041.5	15.62	1.0	20
020	51:22.252 N	002:02.706 E	041.6	46.69	1.0	20
021	51:57.145 N	002:52.725 E	084.9	13.15	1.0	20
022	51:58.304 N	003:13.980 E	082.4	24.71	1.0	20
023	52:01.567 N	003:53.769 E	112.1	7.20	1.0	20

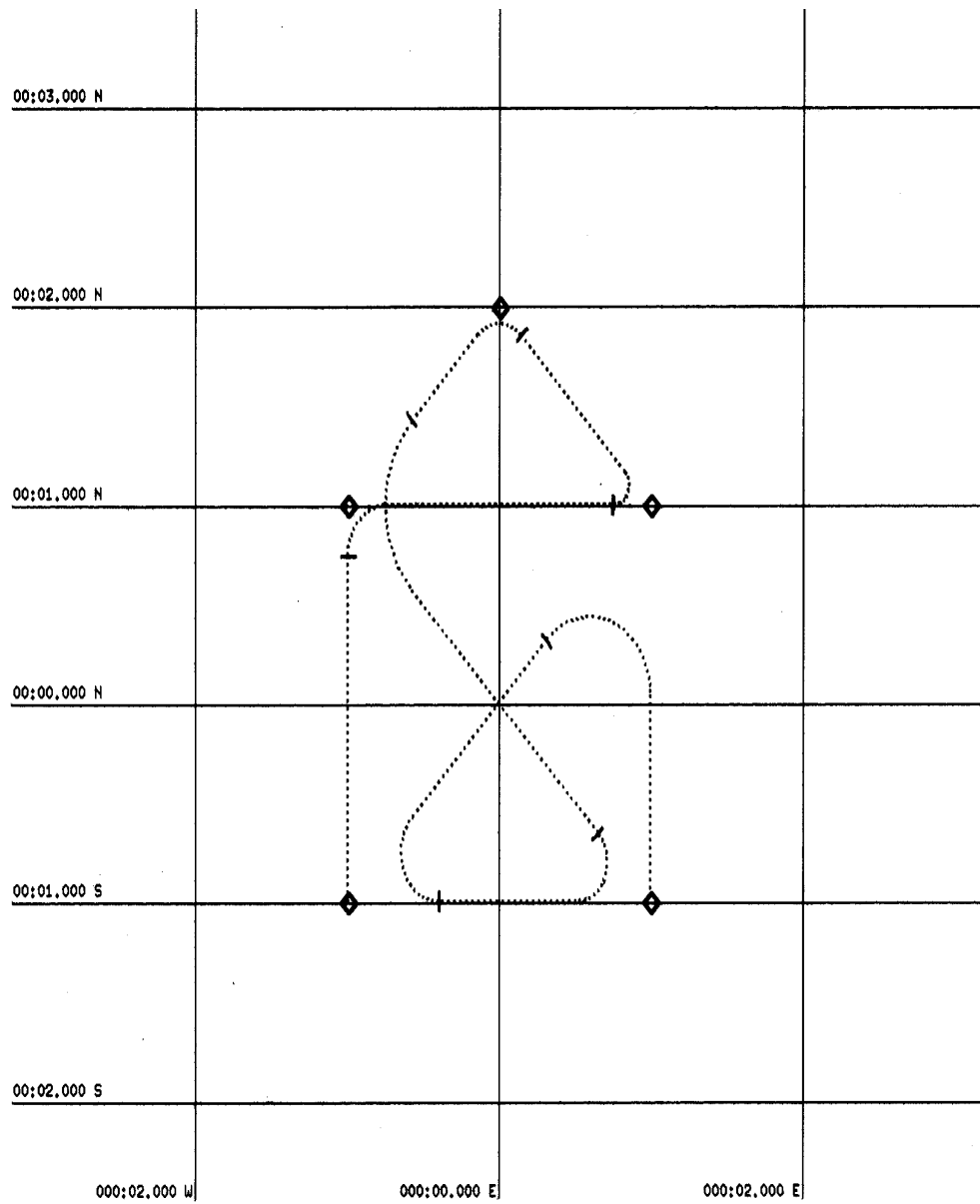
Waypoint No.	Latitude	Longitude	Track [deg]	Distance [NM]	Radius [NM]	R.o.T. [deg/min]
024	51:58.858 N	004:04.605 E				



Scenario 2:

Complex Track at 0 / 0 with Ship class A (50 m / 20 kt)

Waypoint No.	Latitude	Longitude	Track [deg]	Distance [NM]	Radius [NM]	Estimated R.o.T. [deg/min]
001	00:01.000 S	000:01.000 W	000.0	2.00	0.25	80
002	00:01.000 N	000:01.000 W	090.0	2.00	0.25	80
003	00:01.000 N	000:01.000 E	315.0	1.41	0.10	200
004	00:02.000 N	000:00.000 E	225.0	1.41	0.20	100
005	00:01.000 N	000:01.000 W	135.0	2.83	0.60	33
006	00:01.000 S	000:01.000 E	270.0	2.00	0.20	100
007	00:01.000 S	000:01.000 W	045.0	2.83	0.25	80
008	00:01.000 N	000:01.000 E	180.0	2.00	0.40	50
009	00:01.000 S	000:01.000 E				



Scenario 3:**Complex Track at 0 / 180 with Ship class C (300 m / 10 kt)**

Waypoint No.	Latitude	Longitude	Track [deg]	Distance [NM]	Radius [NM]	Estimated R.o.T. [deg/min]
001	00:03.000 S	179:57.000 W	000.0	6.00	1.00	10
002	00:03.000 N	179:57.000 W	270.0	6.00	1.00	10
003	00:03.000 N	179:57.000 E	045.0	4.24	0.50	20
004	00:06.000 N	180:00.000 W	135.0	4.24	1.00	10
005	00:03.000 N	179:57.000 W	225.0	8.49	1.50	7
006	00:03.000 S	179:57.000 E	090.0	6.00	1.00	10
007	00:03.000 S	179:57.000 W	315.0	8.49	0.75	13
008	00:03.000 N	179:57.000 E	180.0	6.00	1.25	8
009	00:03.000 S	179:57.000 E				

